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Index to Advertisers and Classified Index Following Reading Matter.

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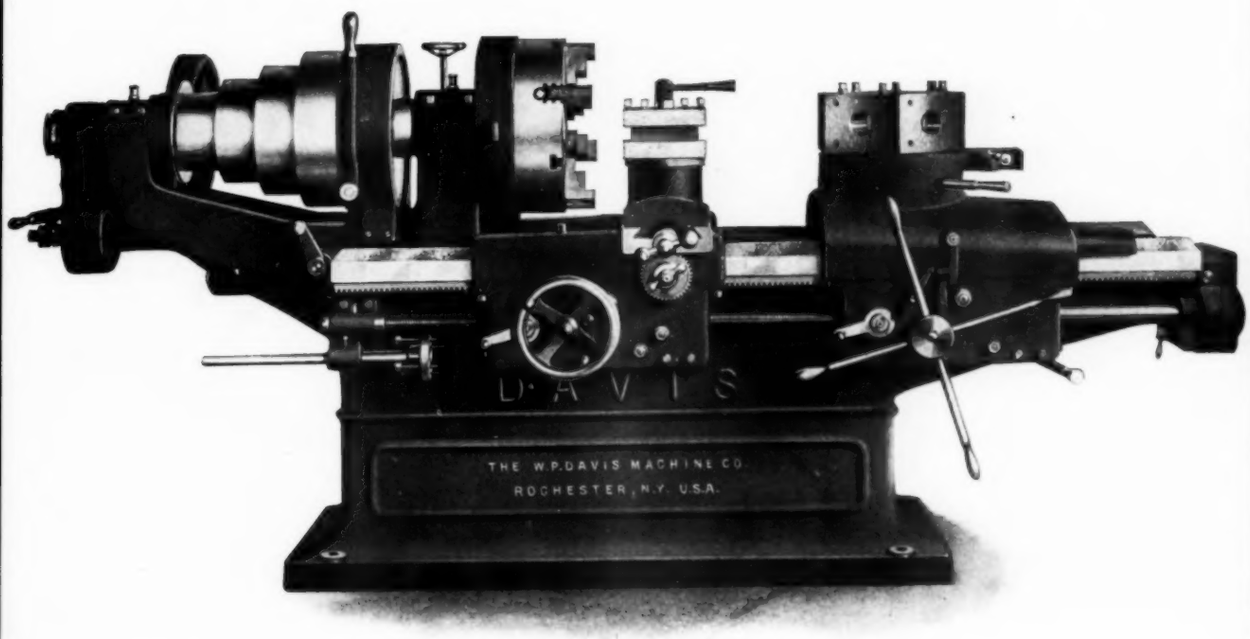

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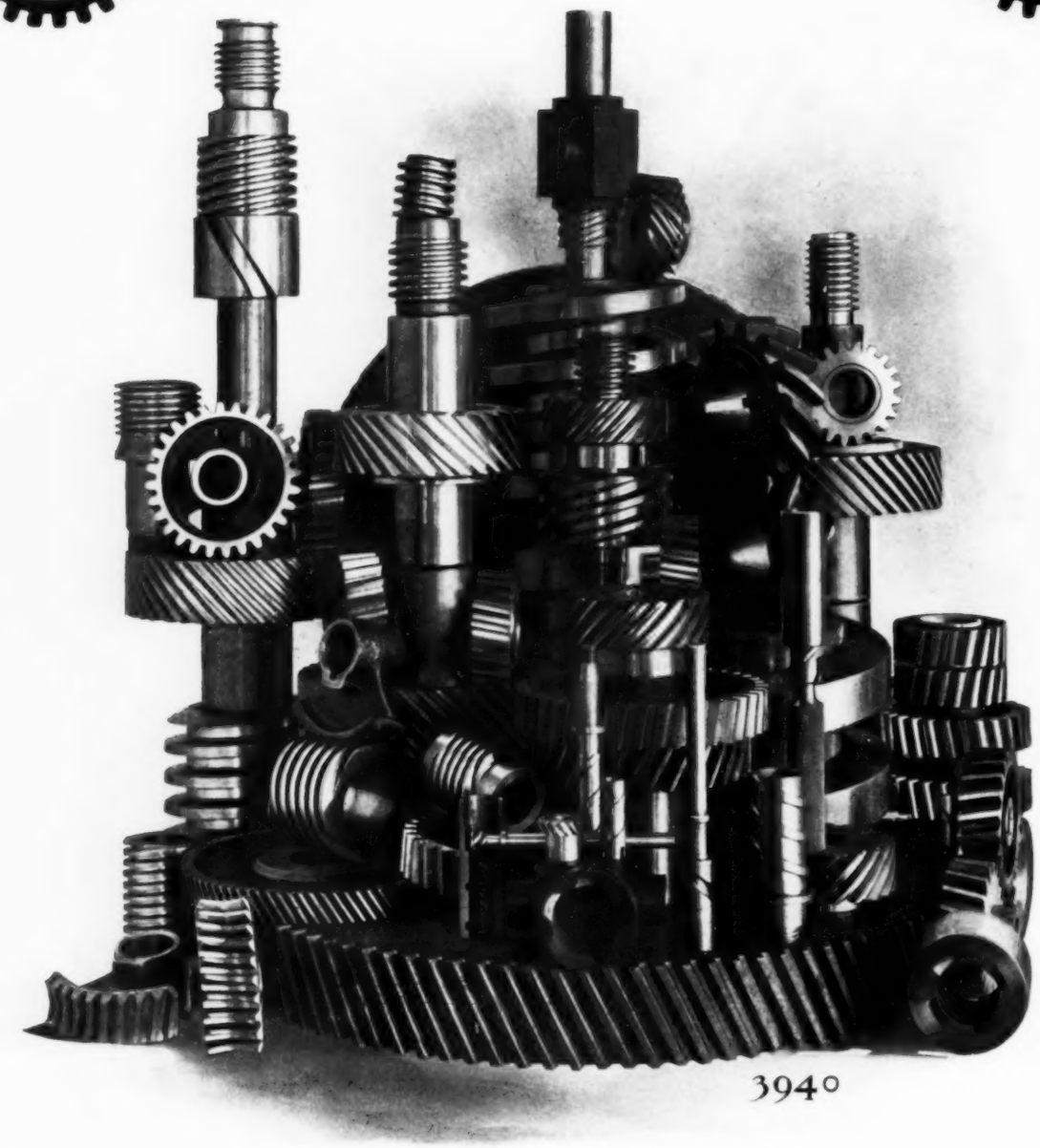

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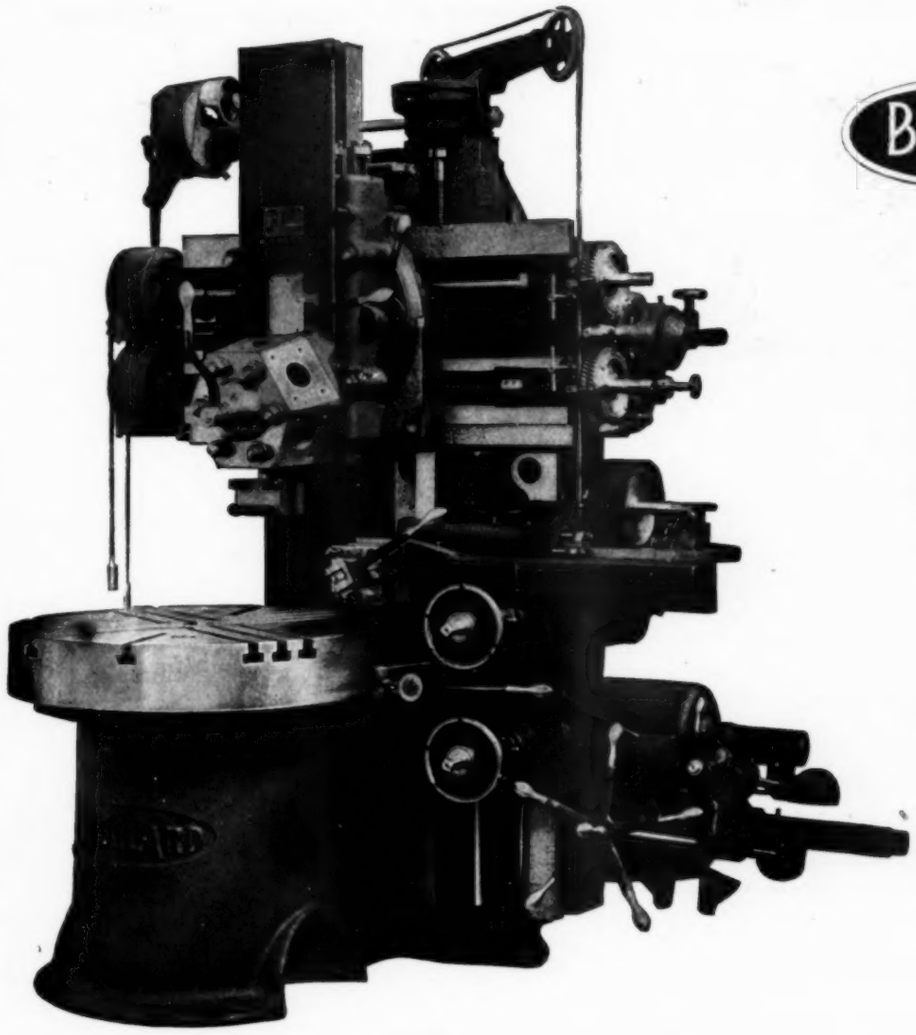

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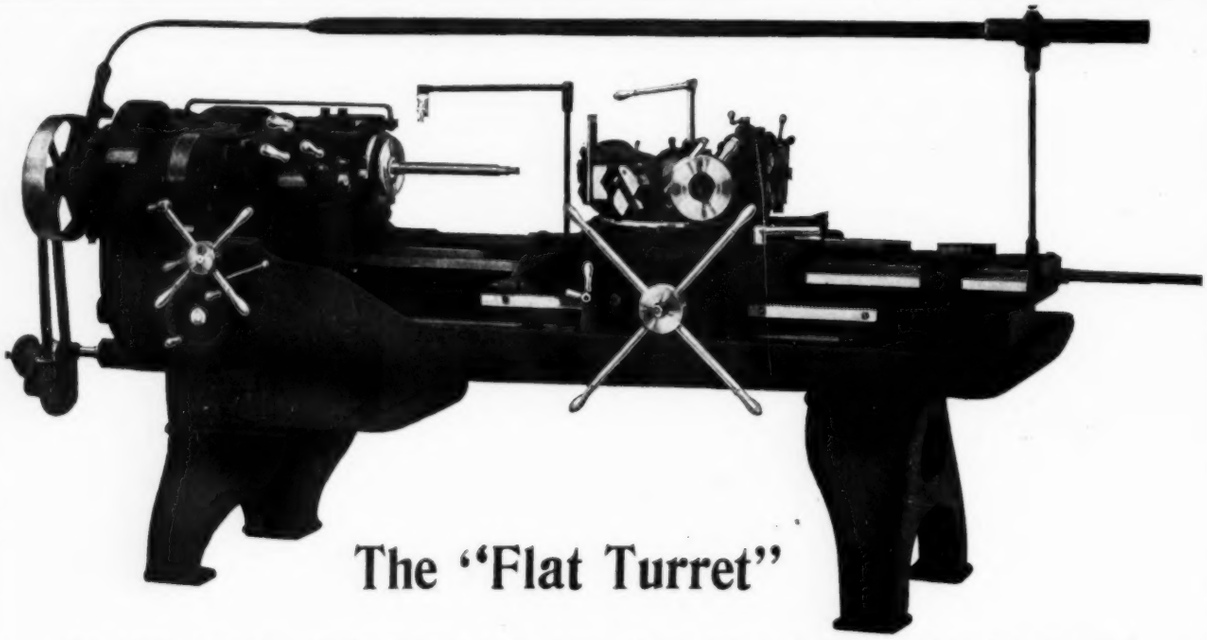

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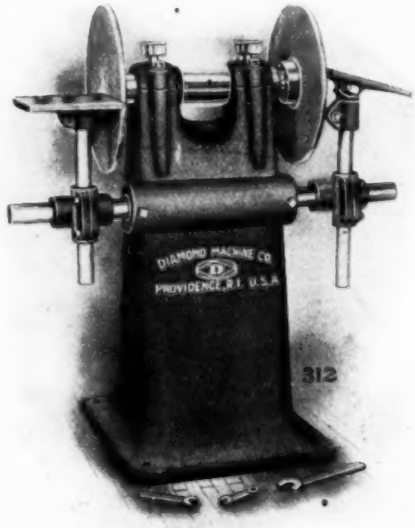


Machining Gasolene Engine Cylinders

The Different Operations of Machining the Cylinder and Its Valve Chamber as Performed by the Cadillac Motor Car Company

EDITORIAL CORRESPONDENCE

In the designing of this cylinder great care was taken to make it as simple as possible, so that the different parts, when worn out or broken by accident, could be replaced by new ones with the removal of few parts. This principle was followed out in the machine operations; all parts of the assembled engine are machined to exact dimensions, so that they are interchangeable and can be replaced by new ones without re-fitting, no matter how long the engine has been in use.

This requires a large number of special tools and jigs; but when these have been once made, the engine parts can be turned out quickly in large numbers, greatly reducing the cost of production. At the same time they can be made to the exact size required, even though it be a long time after the first lot has been turned out.

Design

The Cadillac Motor Car Company has made a success of the single-cylinder gasolene engine, and its four-cylinder engine has been designed so that each cylinder can be cast in a separate piece. The water jacket is made by clamping a spun-copper jacket, as shown by Fig. 3, to the cast-iron cylinder by means of the valve chamber at the top and a cast-iron ring which fits on the flange at the side of the cylinder. These are bolted to the cylinder and the copper jacket is pressed into V-shaped grooves turned in the flange near the middle of the cylinder and also on the top, thus making the jacket act as its own gaskets to make it water tight.

This arrangement makes it much easier, and also cheaper, to replace any worn-out or broken part with a new one. After casting, cleaning, chipping and grinding off the gates and fins, the castings are put in a pickling vat which removes all the molding and core sand, so that it will not clog the passages and pipes. Then the castings are tested under hydraulic pressure to detect any blow-holes or porous iron through which the gases or cooling water circulating through the cylinder might leak.

Boring the Cylinders

When thoroughly tested, they are taken to the machine shop. The first operation there is that of boring, as shown in Fig. 1. This machine is built to bore two cylinders at one time. While these are being bored, two others are being set up on the opposite end of the table. The two cylinders nearest the boring bars have been rough bored and the cutters backed out; the two on the opposite end are ready to be clamped by bringing down the hinged pieces *A* and *B* and fastening them by the hinged bolts. By revolving the table halfway around on the plate *C* these cylinders are ready to be bored.

In each clamp the cylinders have a bearing on four points, two of which are located in the bottom half and two in the

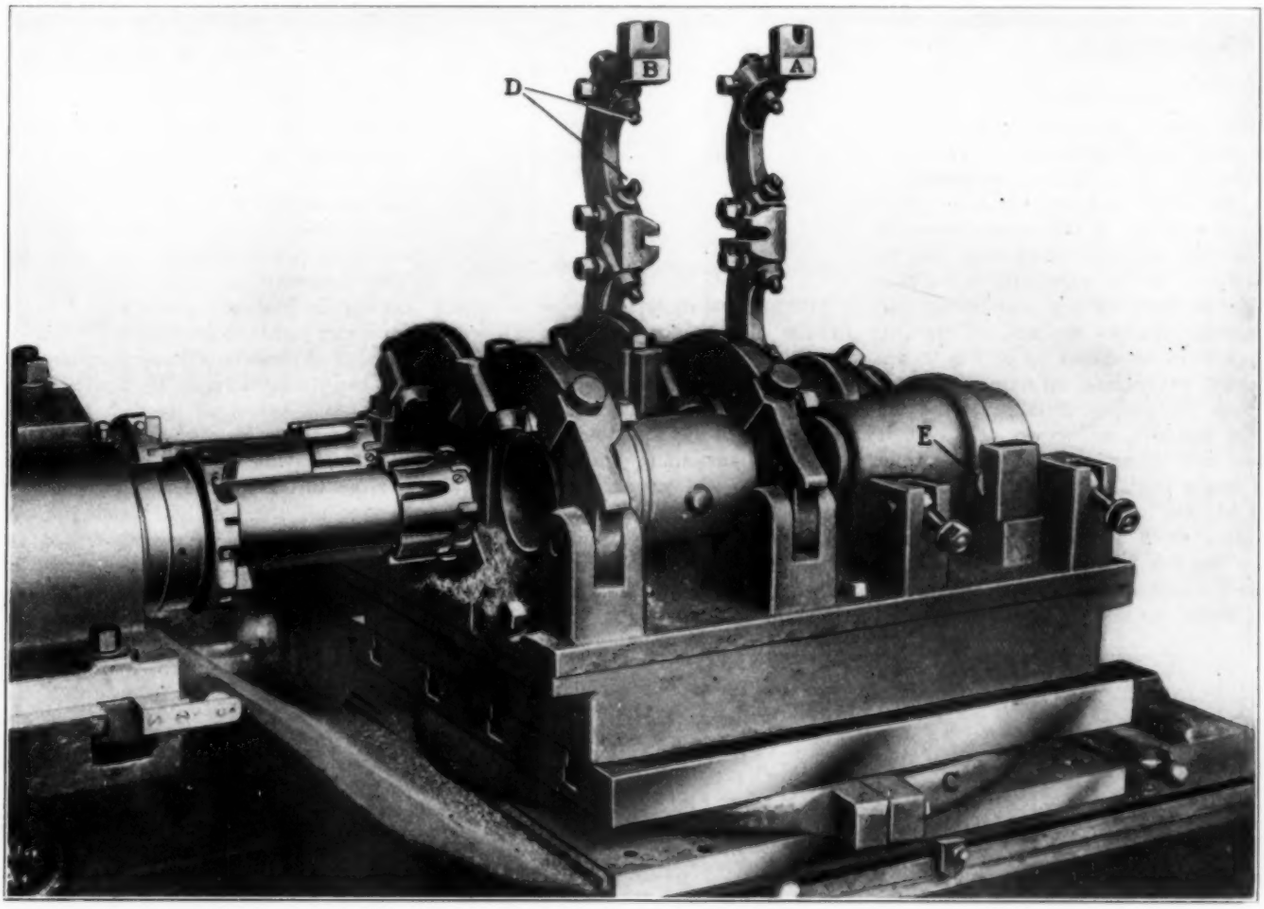


FIG. 1. BORING CYLINDERS

upper half, as shown at *D*. One of these bearing points is marked on the cylinder so that it can be taken out of the machine after rough boring and set aside for a few days before taking the finishing cut, in order to allow any internal strains which may be in the casting to adjust themselves.

The cylinders are prevented from turning by the boss for the water outlet-pipe connection fitting into an opening in a lug on the plate, as shown at *E*. In actual operation the workman has plenty of time to locate the two cylinders to the right of Fig. 1, clamp them in and fasten all of the bolts down ready for the table to turn before the boring bar has finished its cut on the other two cylinders; thus the machine can run continuously and not lose any time by stoppages.

Smoothing Cut

After one lot of engine cylinders has been rough-bored in this machine, the cutter heads are changed for others made to give the smoothing or finishing bore. They are similar to the ones shown in the machine and differ from them only by having four of the eight cutters working loosely in slots. When the boring bar has nearly reached the end of its cut, these cutters, as shown by *F*, Fig. 2, are expanded by running up onto the center *G*; thus for a short distance at the top of the cylinder, as shown at *H*, it is turned out three one-hundredths of an inch larger in diameter than the finished bore will be, in order to give the piston clearance when at the top of its stroke. After the cut is completed, the cutters *F* are drawn back by a spring attached to each cutter, to their original position as the boring bar backs off from the center *G*, so that the bar can pass out through the smaller diameter of the bore.

The cylinders are then turned on the top and flanges in a turret lathe, after which they are reamed out, as shown in Fig. 1. The small bar running from the cutters into the cylinder passes through it to a center in the tailstock of the lathe, to steady the cutting bar.

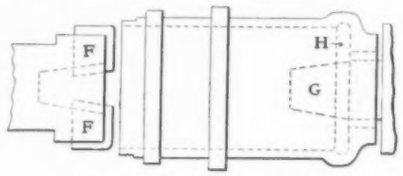


FIG. 2. EXPANDING CUTTERS

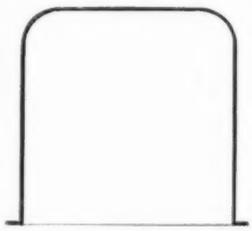


FIG. 3. SPUN-COPPER WATER JACKET

The fine quality of the work is shown by the close limits within which each operation must be performed. The cylinders must be rough bored between 3.960 and 3.964 inches in diameter, which allows a variation of but four-thousandths of an inch; the smoothing bore must be between 3.996 and 3.998 inches, which allows but two-thousandths of an inch variation; the bore when reamed must be between 3.994 and 3.998 inches. Afterward they are ground out to the exact diameter, which in this case is 4 inches.

For each of these operations two solid gages are provided, one of which is the maximum size and too large to enter the bore when tried; the other gage is the minimum size and should enter the bore freely, thus insuring accurate work.

Turning the Outside

The machining of the top and flanges is done in a turret lathe, as shown in Fig. 5. The cylinder is slipped over the disk *I* on the face plate; it is held in position by four sliding lugs and bolts which are put through the face plate at an angle, as shown at *J*. When the cylinder is fastened in position, tool *K* in the turret bores the hole *L* in the end of the cylinder while tool *N* in the cross slide is turning off the face and side of the flange *O*. Tool *M* next swings into position and turns off the face *P* while the two tools *Q Q* are facing the two sides of the flange *R* and the diameter below it which locates the cylinder in the engine case. The special reamer *S* then swings into position and reams out the hole *L* before it is tapped with the tap *T*, which shows the care that is taken to get this hole true. This operation is completed by tool *U* cutting the V-shaped grooves for the copper water jacket to press into.

In all of these operations a variation of but two-thousandths is allowed from the dimensions given, so that all parts will be interchangeable without fitting.

After leaving this machine, the cylinders go to the milling machines and drill presses for the bolt holes and pipe-connection bosses to be milled, drilled and tapped; from here they go to the machine where the bore is reamed out, Fig. 4, and from there to the grinding machines,

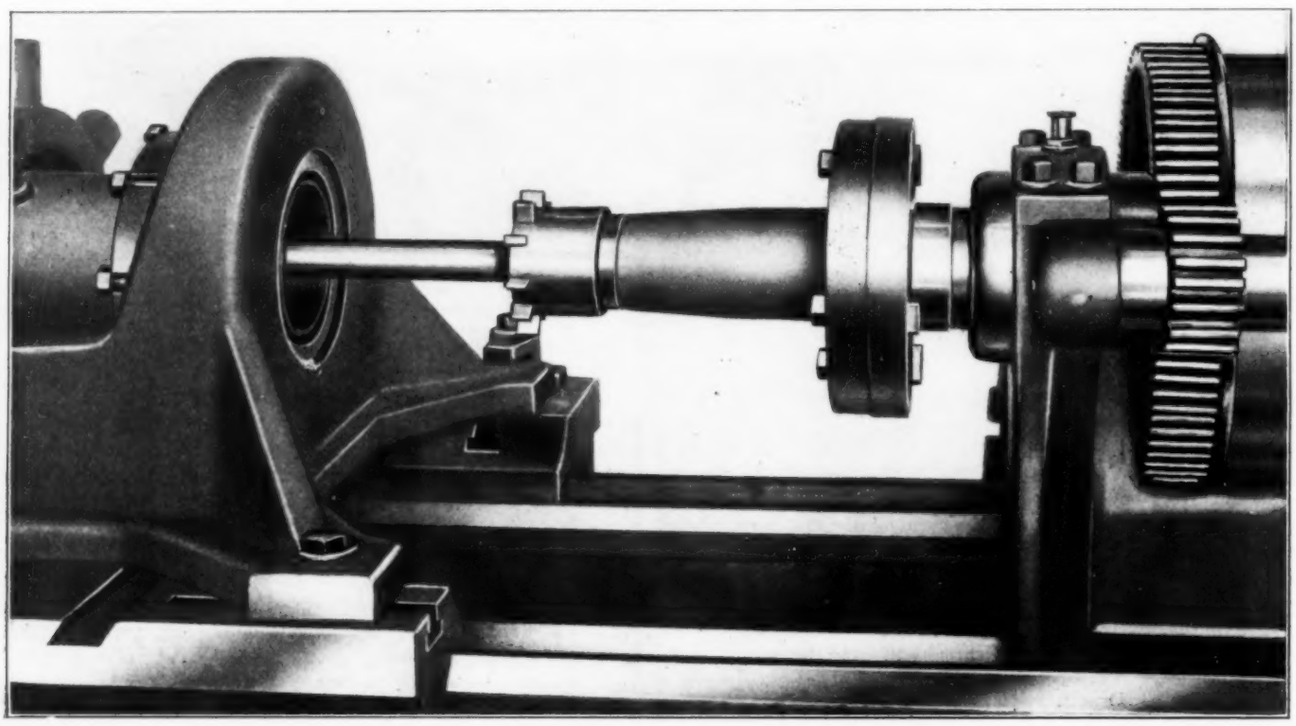


FIG. 4. REAMING THE CYLINDER

for the final operation on the cylinder castings.

The Valve Chamber

The inlet and exhaust valves are both in one casting on the Cadillac four-cylinder engine, which is the one described here; but on the single-cylinder engine they are in separate castings. A slight difference in the machining is required, although the turret lathe is used and nearly the same operations in machining the valve openings.

Fig. 6 shows the four-cylinder valve cage in detail, and Fig. 7 shows it set up in a jig in the turret lathe ready for machining. In this operation it is set to machine valve opening *A*, Fig. 6. The first tool bores the opening *B*, which is afterward tapped with a tap that is on the back side of the turret, hence does not show in the half-tone. It is next counterbored at *C*, again counterbored at *D*, after which it is faced off on the surface *E*, each operation with a different tool. The valve seat at *F* is then finished, after this the valve-stem hole *G* is drilled out by the drill which is shown in position in Fig. 7. On this drill will be seen a loose bushing which is slid into position by the operator and fits in the opening *D* and the valve seat *F* to guide the drill so that it will not spring out of true and drill the hole at an angle. The drill is then removed from the turret; the reamer, which is shown lying on the ways of the lathe, is inserted in its place and the hole *G* reamed out to the exact size wanted. As will be seen, this also has a bushing, similar to that on the drill, to guide it.

When valve opening *A* has been completely machined, the jig is revolved on the face plate until the plug *H*, Fig. 7, strikes the stop *I*. This brings it into position for machining valve opening *J*, Fig. 6,

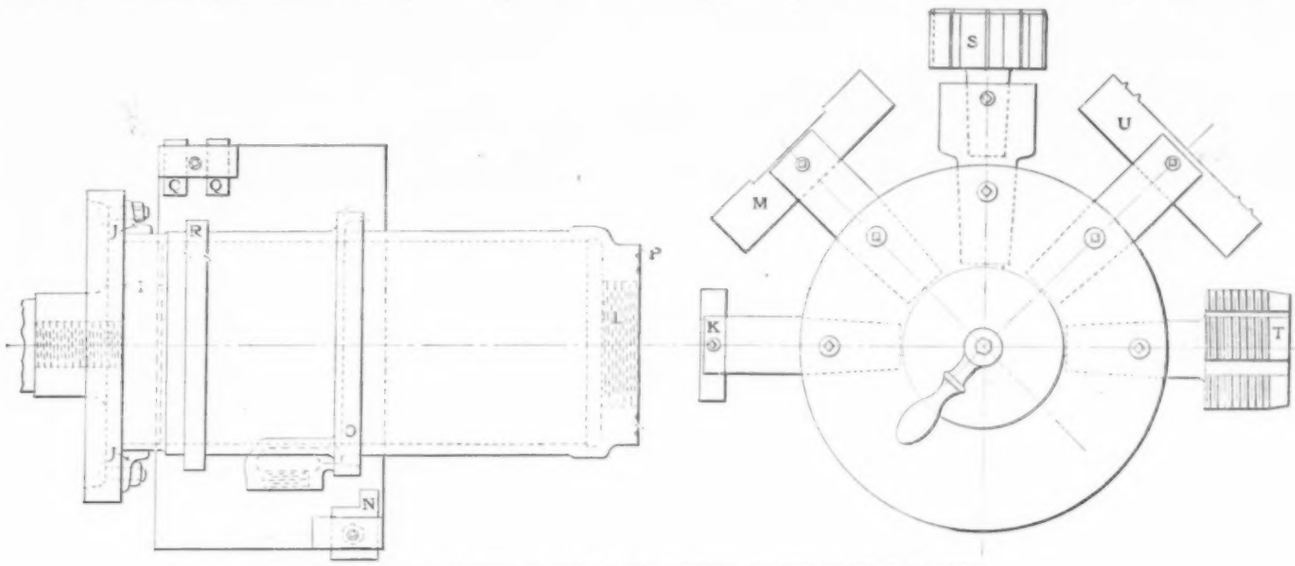


FIG. 5. FACING END, TAPPING AND TURNING FLANGE IN TURRET LATHE

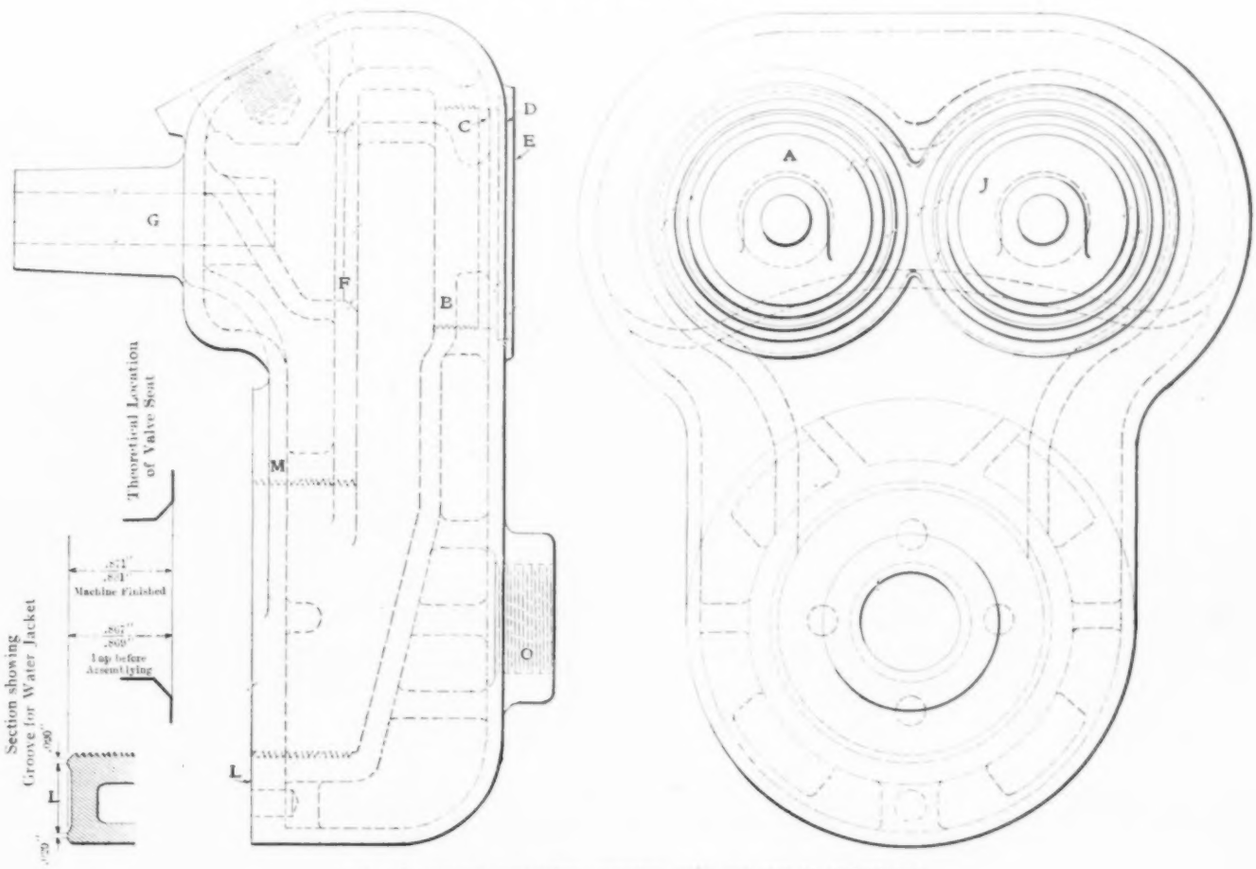


FIG. 6. VALVE CHAMBER WHICH FITS ON TOP OF CYLINDERS

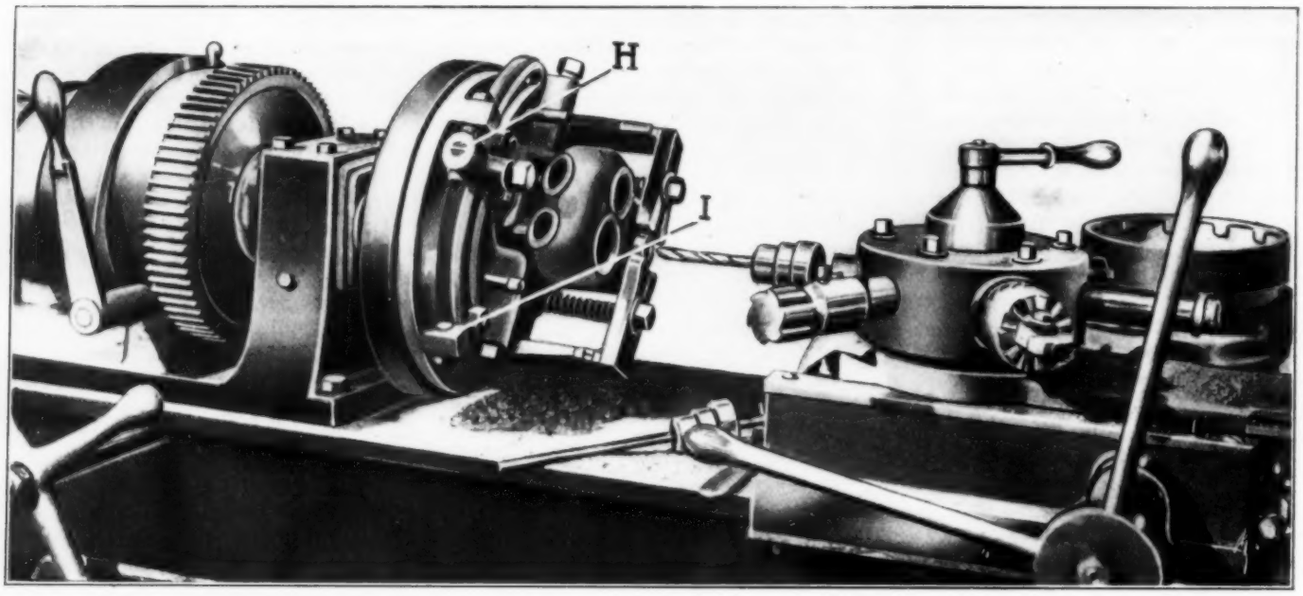


FIG. 7. MACHINING THE VALVE OPENINGS

with the same tools and the same operations as were used in machining valve opening *A*.

Machining the Cylinder Connection

After machining the valve openings, the valve chamber is taken to another turret lathe, as shown in Fig. 8, where the part which is coupled to the cylinder casting is finished. The first operation is performed by moving tool *K* up and facing off the part which bears on the cylinder, as shown at *L*, Fig. 6. Next, the opening at *M* is bored out with tool *N*, Fig. 8, after which it is reamed; the reamer is shown in position in the half-tone. This hole is then tapped out with a tap in the turret, which does not show in the half-tone.

The hole *O* is then bored out with the tool *P*; the valve chambers are taken to the drill presses and milling machines for a few minor operations on the outside, after which they are assembled.

In assembling, a hollow nut is screwed into the tapped hole *M* of the valve chamber and the tapped hole *L* of the cylinder. This nut has a right- and left-hand thread and draws the two parts together tight with the copper water jacket, Fig. 3, between them.

In all of these operations on the valve chamber a variation of but two-thousandths is allowed, with a solid maximum and minimum gage to test each dimension, so that each part is absolutely correct and no fitting will need to be done in assembling.

This shows the care which is taken by the Cadillac Motor Car Company to turn out good work and parts that can at any time be changed for new ones; this closeness of work is absolutely necessary to produce a smooth-running gasolene engine that will give the best wearing results.

E. F. L.

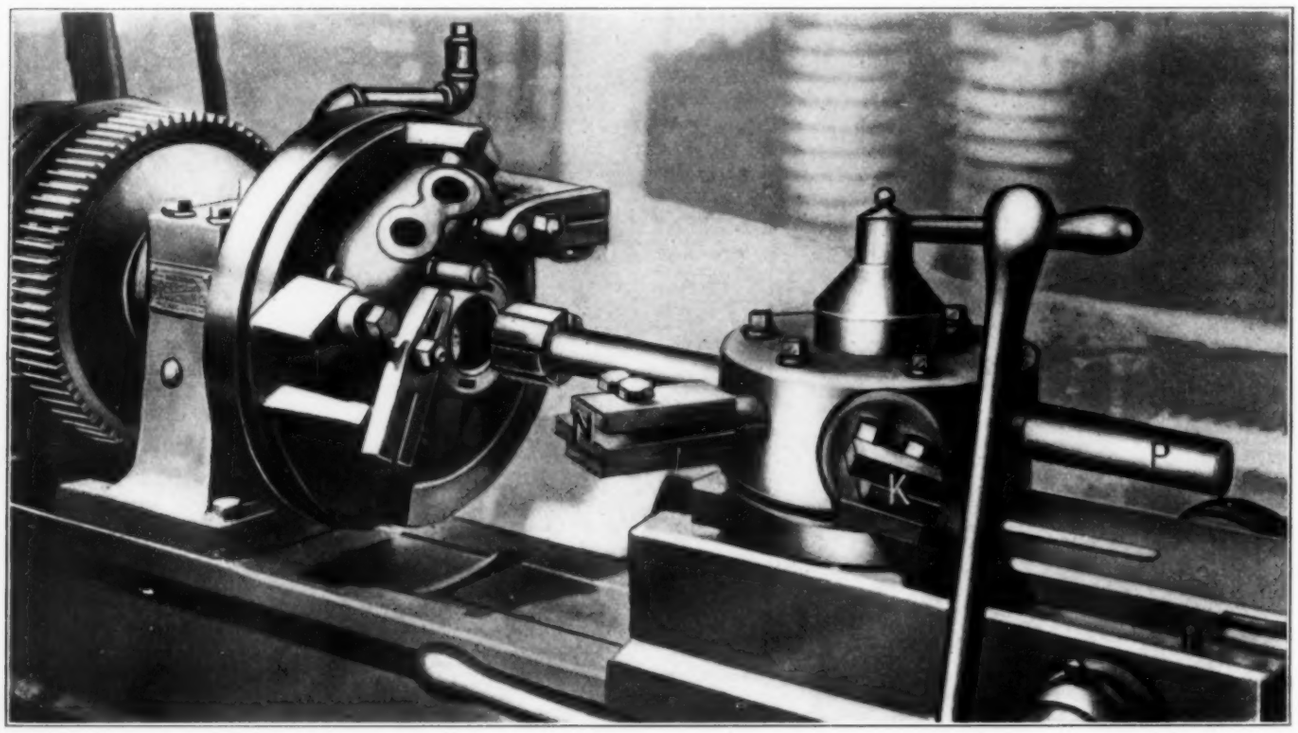


FIG. 8. MACHINING THE CYLINDER CONNECTIONS

Accurate Lapping Operations and Small Tools

How the Members of the Mold Used in the Monotype Casting Machine Are Finished Accurately by Grinding and Lapping

EDITORIAL CORRESPONDENCE

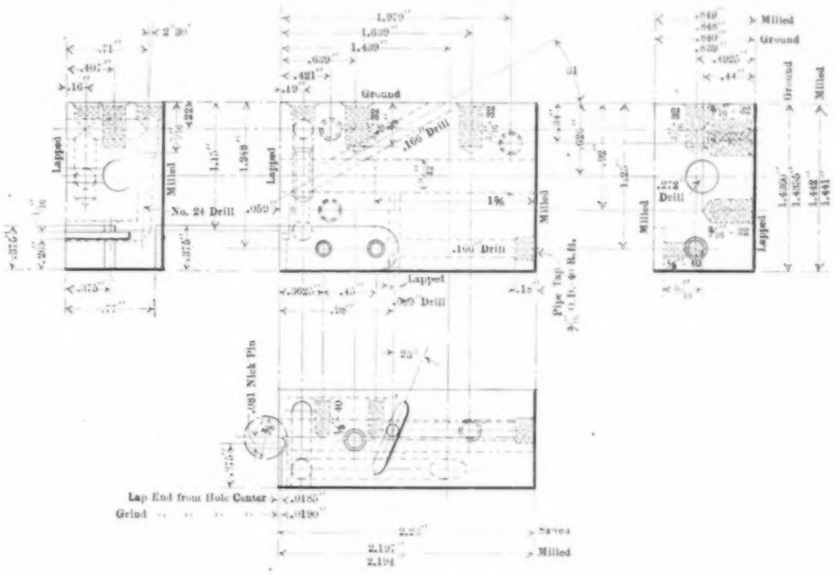
In a recent issue of this journal a description was given of some of the operations performed at the shops of the Lanston Monotype Machine Company, at Philadelphia, in the production of the matrices used on the Monotype casting machine. Reference was also made at that time to the mold, which in conjunction with a series of matrices rapidly produces the type one by one, the movements of the matrix case over the mold for the casting of the characters in the desired order being controlled automatically by a perforated paper ribbon previously punched in a keyboard machine by the compositor. As stated in the article referred to, the mold as well as the matrix is made with great nicety; some of the appliances and methods utilized in the preparation of the molds will be described in the present article.

The Monotype Mold

In the first place let us consider for a moment the mold construction, which is shown pretty clearly (about half size) in Figs. 1 and 2, representing respectively front and rear views, or perhaps it may be preferable to say top and bottom views, as the mold is actually carried in the machine in horizontal position, with the matrix case and its 225 characters directly above. The mold is built up of a considerable number of hardened-steel parts accurately positioned and each secured firmly in place, with the exception of a couple of sliding members which are guided in their reciprocations between perfectly true and perpendicular surfaces formed on retaining members at either side. When we say "perfectly true surfaces," we mean here surfaces as finished by careful grinding and lapping operations accompanied by refined tests with accurate measuring tools and inspecting appliances which facilitate as well the production of surfaces parallel and perpendicular to one another.

Operation of the Mold

The type body is cast in the opening *A*, Fig. 1, the matrix of course being centered directly over the mold during the



One of Tool Steel - Harden

FIG. 3. TYPE BLOCK FOR MONOTYPE MOLD

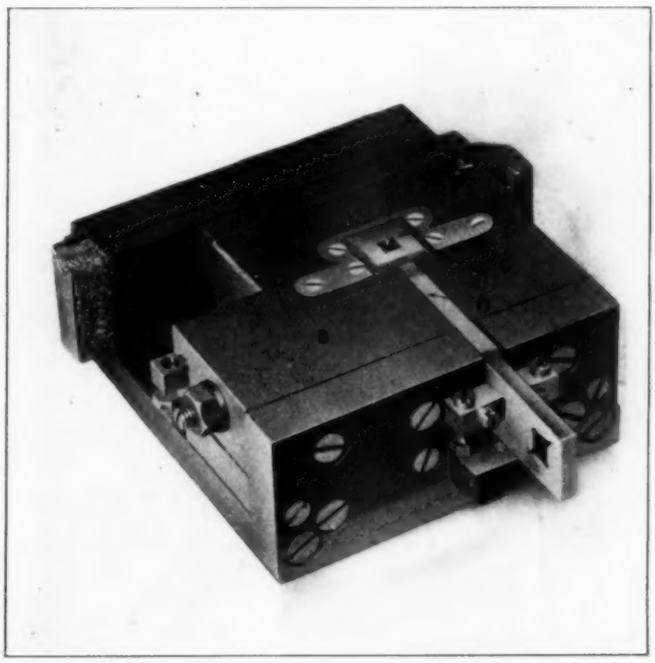


FIG. 1

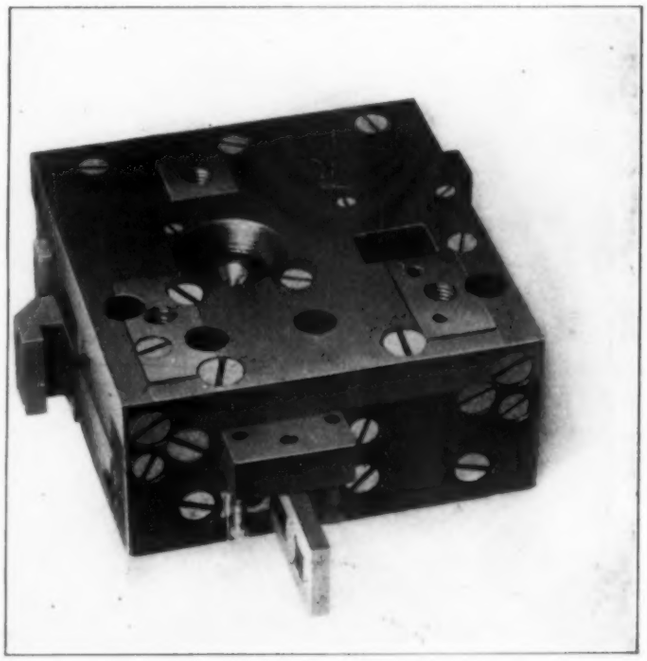
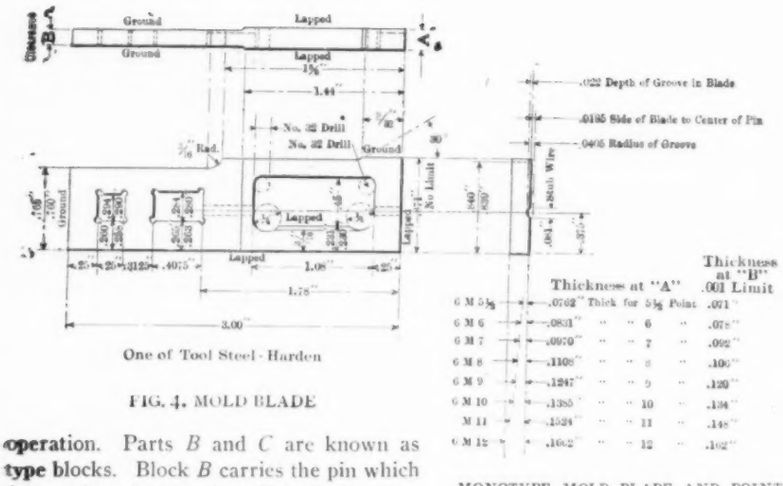


FIG. 2

MONOTYPE CASTING MACHINE MOLD


Ground
Lapped
Ground
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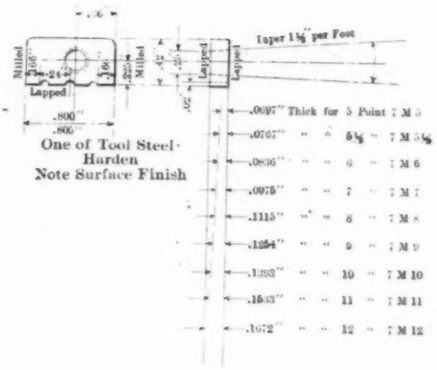
1⅝"
1.44"
No. 32 Drill
No. 32 Drill
Ground
Rad.
Lapped
Lapped
Lapped
1.08"
1.78"
3.00"
.022 Depth of Groove in Blade
.0185 Side of Blade to Center of Pin
.0405 Radius of Groove
.86 Stub Wire
Thickness at "A"
Thickness at "B" .001 Limit
6 M 5½ .0762" Thick for 5½ Point .071"
6 M 6 .0831" " " 6 " .078"
6 M 7 .0970" " " 7 " .092"
6 M 8 .1108" " " 8 " .106"
6 M 9 .1247" " " 9 " .120"
6 M 10 .1385" " " 10 " .134"
M 11 .1524" " " 11 " .148"
6 M 12 .1662" " " 12 " .162"

One of Tool Steel - Harden

FIG. 4. MOLD BLADE

MONOTYPE MOLD BLADE AND POINT BLOCK


Taper 1½" per Foot
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One of Tool Steel
Harden
Note Surface Finish
.0697" Thick for 5 Point 7 M 5
.0767" " " 5½ " 7 M 5½
.0836" " " 6 " 7 M 6
.0975" " " 7 " 7 M 7
.1115" " " 8 " 7 M 8
.1254" " " 9 " 7 M 9
.1393" " " 10 " 7 M 10
.1533" " " 11 " 7 M 11
.1672" " " 12 " 7 M 12

FIG. 5. POINT BLOCK

operation. Parts *B* and *C* are known as type blocks. Block *B* carries the pin which forms the nick in the side of the type. Part *D* at the back of the mold is known as the mold blade, and *E* at the front is the cross block. The mold blade *D* is made the width of the "point" size of the type and is slid in and out automatically to give the various widths of opening required for the different letters. After the type is cast, the cross block *E*, through an opening in which the molten metal is pumped from underneath the mold, is slid to one side by a member not shown, known as the type carrier, which upon coming opposite the type receives the latter, which is pushed out of the mold by the blade *D*. The type carrier then moves away from the mold with the type and in doing so brings the cross block *E* back in front of the mold again, which is then ready for casting the next letter.

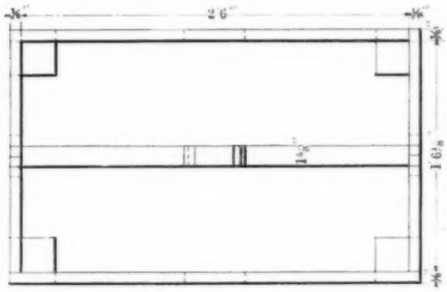
It will be pretty generally understood that the different parts composing this mold have to be just about right before assembling on the base block. Especially will the importance of accuracy in the four parts forming the walls of the mold opening be appreciated when it is taken into consideration that if there is any lack of parallelism between the opposite members forming the sides of the type, the error will be multiplied throughout the line of type set up, the total error of course increasing with the length of the line and naturally producing anything but a straight line. Therefore the end of the mold blade and the corresponding face of the

FIG. 6. A ROW OF LAPS IN THE MOLD DEPARTMENT

cross block *E*, as well as the ends of the type blocks *B* and *C*, are made just as near square with their bottom edges and sides as it is possible to make them, with careful grinding and lapping operations.

blade; the latter is then held down to its seat on the base block of the mold by the point block, which has an ingenious and positive means of location through a conical surface on a screw whose slotted head is reached from the exterior of the mold.

The dimensions of the point block are given in Fig. 5, and the number of ten-thousandths freedom which the mold blade Fig. 4 has in sliding between the two type blocks *B* and *C*, Fig. 1, will be seen by comparing the figures giving the thickness of the various point blocks with the corresponding mold-blade thicknesses in Fig. 4.



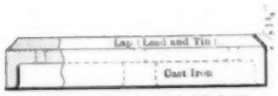


FIG. 7. END VIEW OF LAP

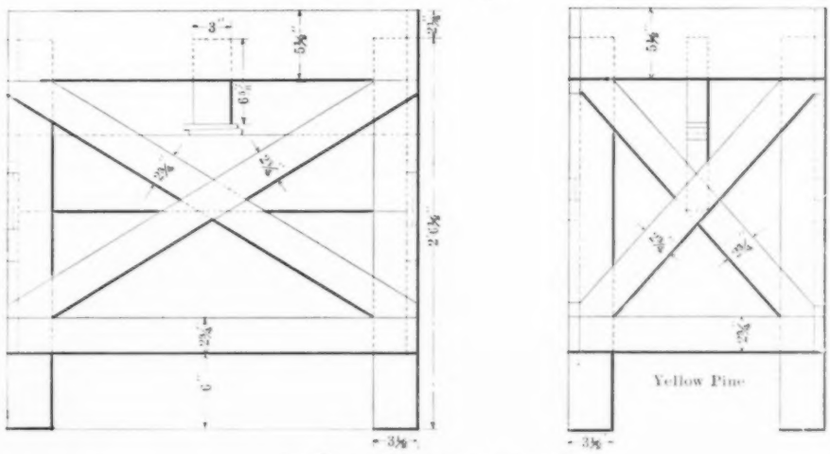


FIG. 8. STAND FOR LARGE LAPS

Grinding and Lapping

After the various blocks entering into the construction of the mold have been cut off and milled to the milling dimensions which are given on the different drawings in the manner indicated in the line engravings, Figs. 3, 4 and 5, the work is hardened and is ready for grinding. For this operation the magnetic chuck is used extensively on the surface grinder; the surfaces are gotten into excellent condition and pretty well down toward finish dimensions before being taken in hand for lapping.

The lapping of these mold parts is one of the most interesting of the many important processes at these shops. Indeed the work might well be called lapping extraordinary, on such an extensive scale is it carried on. An excellent view of a row of laps in the mold department is presented in Fig. 6, and this illustration will help convey some idea of the extent to which the finishing of mold members is done by lapping. There are in this de-

Operations on the Mold Parts

The drawings, Figs. 3, 4 and 5, may be of interest as showing the method used at the Monotype shops of figuring their mold drawings, indicating the successive operations and the allowances and limits for various operations. Fig. 3 is a working drawing of the type block shown at *B*, Fig. 1. The opposite type block *C* is not represented here by a line drawing, as its construction is much the same as that of its fellow block seen in Fig. 3. Both blocks as well as other parts, are provided with internal channels through which water is circulated for keeping the mold cool. The mold blade shown in place at *B*, Fig. 1, is represented in detail in Fig. 4, this drawing giving in tabular form the thickness of the body of the blade for the different sizes of type from 5½ to 12 point.

When the mold is assembled, a spacing block, Fig. 5, called the "point block," is placed between the two type blocks, allowing the mold blade to slide just nicely back and forth between the type blocks. The rectangular opening shown in the mold blade in Fig. 4 forms a pocket for admitting the point block between the type blocks and is enough larger than the point block to allow the mold blade to travel back and forth as far as necessary. The lower edge of the point block is lapped to correspond with the lapped surface forming the bottom of the opening in the mold

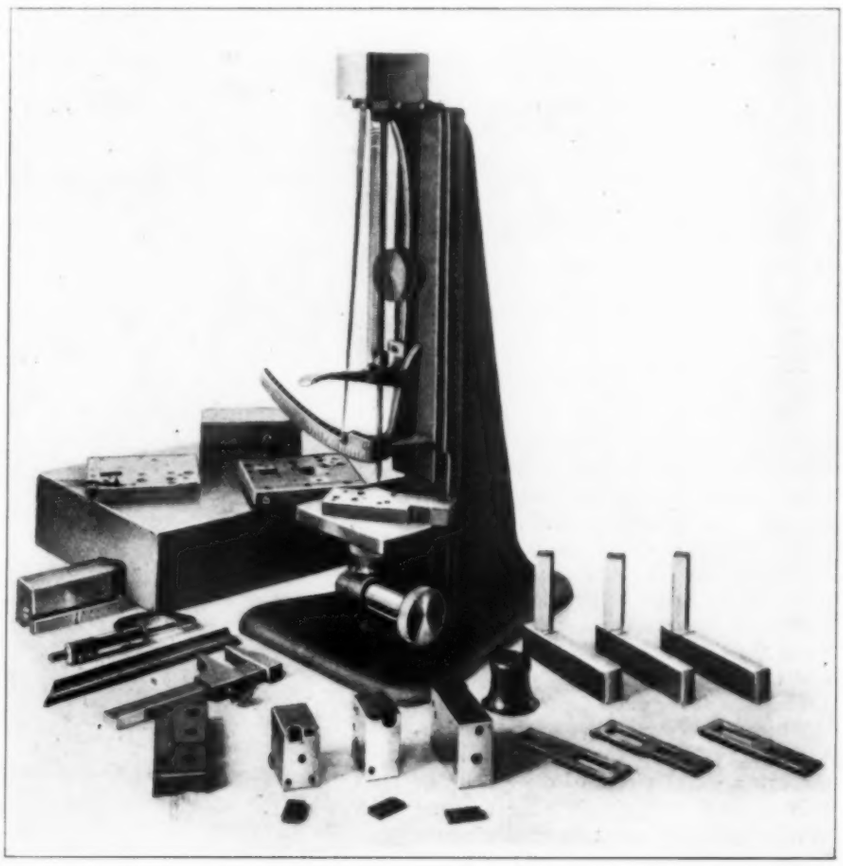


FIG. 9. HARDENED STEEL MOLD PARTS AND THE TOOLS USED IN INSPECTING THEM

partment twenty laps such as are shown in this photograph, and all of them are in pretty constant use.

Some Large Laps

These laps are about 15x27 inches on the face; they are composed of a mixture of tin and lead in equal proportions, the soft-metal facing being poured onto a cast-iron frame or plate so that a section through the lap would appear about as indicated by Fig. 7. The wooden frame on which the laps are supported is shown in Fig. 8. The surfaces of the laps retain their truth for a considerable length of time, owing to their large area and the fact that the work as a rule is passed well across the lap in being moved to and fro, thus avoiding to a certain extent the tendency for the surface to wear hollow in the center, as would be the case were the work to be merely rubbed about a comparatively small section near the middle of the lap. The framework on which each lap is mounted has a wedge under the central post so that the center of the lap is always well supported. Whenever it is found necessary to do so, the laps are trued up by going over them with another lap, testing with straight-edge and plate until the surface is again found to be correct.

Ordinarily the greater part of the lapping is done by using No. 120 emery, and finishing with F emery. Each workman has also at his elbow, on the bench, a plate on which he rubs the work as he takes it from the lap, without, however, any abrasive between it and the bench plate, this being merely a final smoothing operation. The laps are charged by means of a large roller shown in the hands of the workman about halfway down the line in Fig. 6. This roll is of cast iron and weighs probably 75 pounds.

The men in the mold department naturally become very proficient in the manipulation of work on the laps; in putting through a lot of pieces of the same size, they can tell very closely after the first one is lapped just about how many passes across the lap will be required in finishing the surfaces on the rest of the pieces. Here is a case where experience and sense of touch count for a good deal. The mold parts thus handled may be said to be finished with the precision almost of standard gages.

Some Accurate Small Tools

In the half-tone, Fig. 9, are shown some of the measuring and testing appliances used in connection with the finishing of the mold parts. In the foreground of this illustration will be seen a number of the type blocks, already referred to and shown in other illustrations, and several mold blades and point blocks; while on the cast-iron block at the left are a couple of mold base plates, upon which the various parts of the mold are to be built up. It should be stated that while a number of the holes shown in the various pieces are for screws and dowels, others are a part of the system of passages in the various members, which allow of circulation of water for keeping the mold cool at all times.

The bench comparator, at the center of the group, is a sensitive machine for testing the parallelism of various plates. The contact pointer is brought down to the surface of the work by the spring lever, which when drawn downward by the hand assures a delicate contact between the work and indicator. The indicator or pointer, which swings over the curved scale at the front, shows variations in the surface of the work to ten-thousandths of an inch. Three of the knife-edged squares already referred to as used so generally in the nice work at this plant are also shown in this photograph, just to the right of the comparator.

The gage lying to the right of the knife-edge straight-edge is used extensively on this class of work in testing parts for parallelism. The jaws are at a very slight angle with each other, the

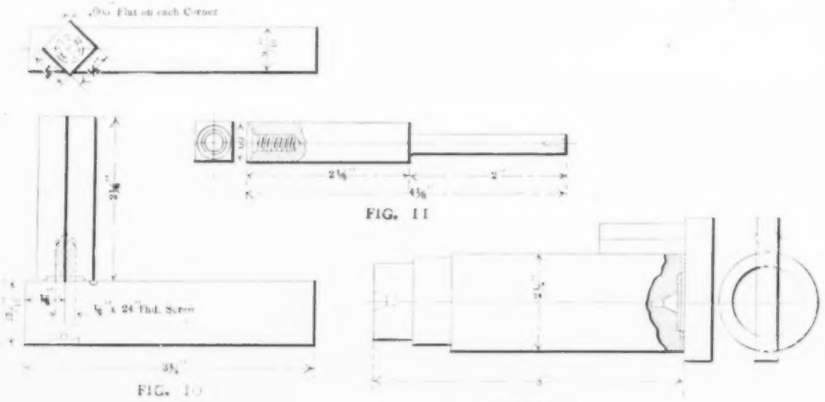


FIG. 11

FIG. 12

KNIFE-EDGE SQUARE

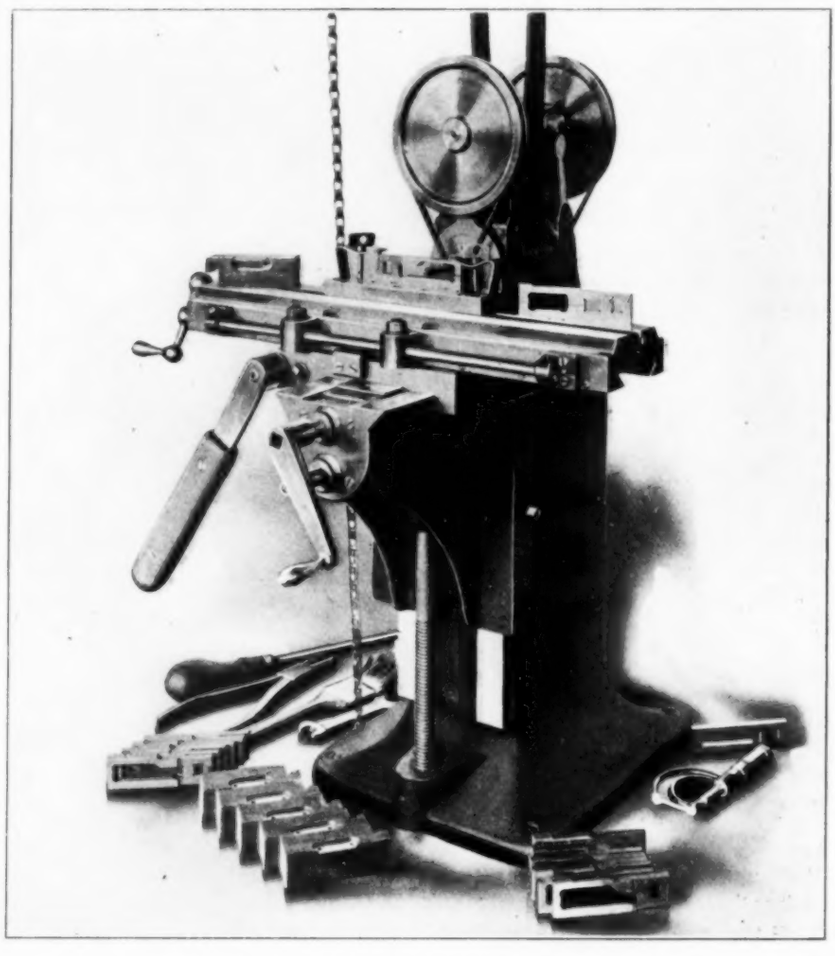


FIG. 13. A SPECIAL GRINDING MACHINE

opening between them being about 0.001 inch wider at the outer end than at the inner. Graduations along the jaw edges indicate differences by 0.0001 inch in the opening; by slipping the gage over the edge of a piece and noting the graduation to which it corresponds, a basis of comparison with other parts of the piece is secured at once.

How the Square is Made

Details of the knife-edge squares referred to are shown in the sketch, Fig. 10, which gives the dimensions of blade and butt. In making the blade, a piece of steel is turned up about as indicated in Fig. 11, with a small shank at one end; this piece is put between the dividing-head centers on the milling machine and milled square. After hardening, it is ground square on the surface grinder, still on centers; then in the cylindrical grinder the corners are knocked off, giving a flat of about five-thousandths of an inch. After assembling, it is tested for accuracy by placing against the master plug, as in Fig. 12. The latter is approximately of the dimensions given. It is ground perfectly straight and the surface at the end against which the butt of the square is held is absolutely square with the axis of the plug. It is, of course, a comparatively easy test plug to make and is easily kept in order by grinding and lapping the cylindrical surface whenever necessary.

The men who use the squares have, of course, testing blocks to try them on whenever necessary; owing to the shape of the blades, whenever the opposite corners used for external and internal work become unsuitable for use the blade may be turned a quarter way round to present two fresh corners to work from. When the four corners need truing up again, this may be done by placing the blade on the surface grinder, then lapping the sides and the corners until again square with the master test piece.

An Interesting Special Grinder

Fig. 13 illustrates an interesting grinder used for a variety of internal work, such, for instance, as finishing the rectangular openings in the mold blades and the round-ended pockets in the tops of the type blocks, which receive the matrix seats. Two rubber bands at the ends of the spindle do the driving from the larger pulleys on the main shaft in the head. The operator moves the table to and fro between stops and finishes the surfaces rapidly and accurately. F. A. S.

Milling Screwdriver Spirals

By Ethan Viall

One of the first patents taken out on the now familiar spiral drills and screwdrivers was by Anton Schuermann, the present foreman of our experimental room. This patent was issued to him July 30, 1889, and consequently is no longer in force. As the firm has long since discontinued their manufacture, a description of the machine used to mill the spiral may be of interest. This machine was designed and built by Schuermann himself, the master spirals being cut in an ordinary lathe, which in itself was no small task.

Referring to Fig. 1, the box or sleeve in which the master spiral runs is stationary, though pivoted to allow a slight easing movement. It may also be slid along the ways and clamped wherever desired. The front end of the master spiral, which holds the split chuck, passes through a sleeve which allows it to turn freely. This sleeve is fastened to the movable carriage. The carriage may be moved either by hand or power the same as a lathe carriage, except that when moved by power a trip is used which stops the feed at the proper place.

In milling a screw-driver spiral, one end of the blank was run through the bushing under the milling cutter and the other end clamped in the split chuck. As the carriage fed forward, the stationary sleeve caused the master spiral to rotate, which in turn rotated the screwdriver blank as it fed under the cutter, the result being a spiral groove. After one groove was milled, the carriage was drawn back and the chuck indexed just half a turn by means of the stop pin shown on top of the split chuck. The other groove was then milled. This completed the milling operations, as only two spiral grooves were used.

Fig. 2 shows the shape of the hardened bushings under the milling cutter, through which the blank was fed; a part of the feed trip is also shown. Most of the latter mechanism is under the carriage and impossible to photograph.

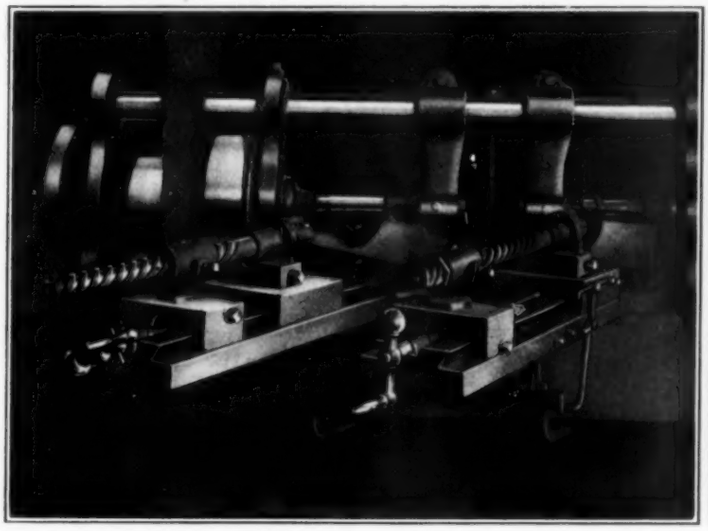


FIG. 1. GENERAL VIEW OF SPIRAL MILLING ATTACHMENT

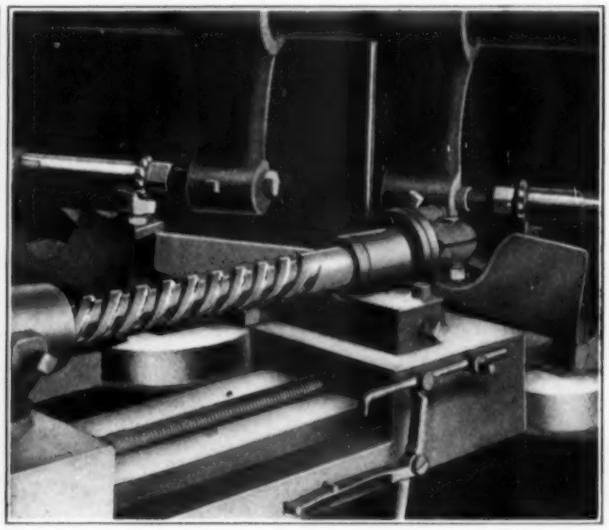


FIG. 2. SOME OF THE DETAILS

As will be seen in both views, the machine was rigged up to cut two spindles at once. The arrangement of the heads with the continuous bar for the spindle supports is interesting, as is the very light support for the boxes of the main spindle.

It is estimated that 150,000,000 tons of coal are used annually by the railways of the United States, out of which but 7,500,000 tons are used in drawing the trains, while 142,500,000 tons go up the smoke stacks.

Reports show that 12,091 tons of tin, valued at over $7,300,000, was produced in Australia during 1906, being 1725 tons more than in 1905. The following quantities of tin were mined last year in each of the producing States: New South Wales, 1300 tons; Queensland, 4823 tons; Tasmania, 4473 tons; and Western Australia, 1495 tons.

Tool-room Arrangement and System

Points to be Considered in Laying Out, in Fitting Up with Racks and Boxes and in General Management

BY WILLIAM H. TAYLOR

The tool room in the average shop evolves itself when its need is felt. A small room or space is generally selected for its location; it is equipped with racks and drawers, and no further expenditure of money is expected. It is not worked out for further additions, it does not permit of rearrangement to accommodate the increasing demand for tool storage as the business grows; the racks, cabinets, trays, etc., are not located and arranged in accordance with any system or scheme for a general classification to render identification of the tools immediate and simple; even at this stage it is wholly inadequate to accommodate the immediate needs. As time rolls on, it becomes a conglomeration which is inextricable and can be handled only by the man or men who grew up with it; in event of his retirement from its charge, months are consumed before his successor becomes familiar with or can locate the tools with any degree of alacrity.

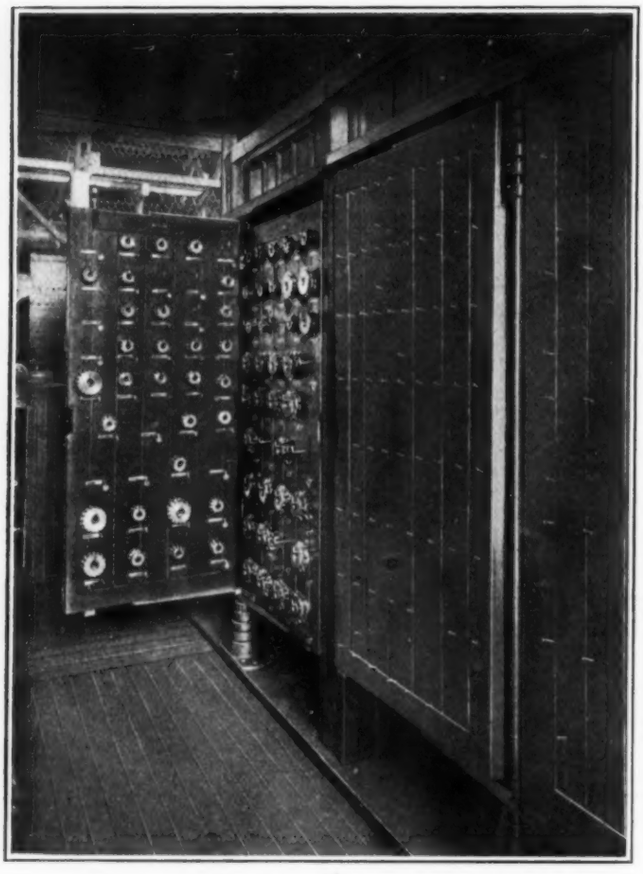


PHOTO A A. SECTION "R" SWINGING DOOR CABINET

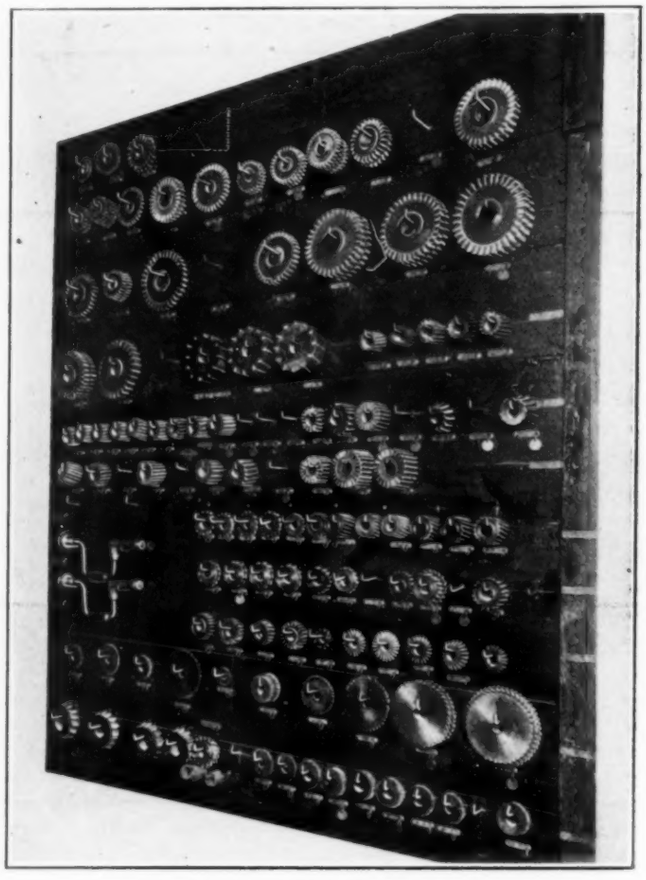


PHOTO B. SLIDING DOOR RACKS FOR TOOLS

As a rule an attempt is made to stock only a small percentage of the cutting tools, such as milling cutters, taps, drills, reamers and a few gages. The bolts, clamps, blocks, drivers, wrenches, paring tools, etc., are seldom placed in the tool room, but are left at the machine, where they rapidly become scrap. It is a very common occurrence in the average shop to see a machinist spend from ten to fifteen minutes attempting to fit a nut on a bolt whose threads have either become stripped or hopelessly burred.

If you have ever noticed how the average job is clamped on the machine, you will find that the bolts used to hold it are from one to three inches too long and that considerable time is wasted in screwing the nut off and on this surplus length, or else time is spent hunting scrap of various sorts to be used as washers.

The blocks to be placed under one end of the clamp are never stored in the tool room; when the workman receives a job requiring blocks, he must take time to go to the carpenter shop to procure them, and by the time he receives the next similar job the blocks have become lost and new ones must be furnished. It is therefore of vital importance that all the appliances required to complete a job should be returned to the tool room immediately after a job is finished; there they should be carefully inspected, and any necessary repairs should be made before they are distributed to their respective racks and boxes so as to assure their being in perfect condition when assigned to the next job.

In the average shop you have observed that drills and sockets are generally kept at the drill presses and that the tangs of both the drills and the sockets are frequently twisted off; as the operator has no means of repairing them, or for lack of interest, he will use them in that condition, with the result that the drills cannot be run at anything like their maximum speed.

I could continue citing these innumerable abuses which must be apparent to all shop practitioners, but space forbids all but summing up an evident fact, that if these abuses are permitted to continue,

instead of money being invested in efficient tools, you will find your money invested in scrap.

The whole scheme of shop management amounts to keeping the machines producing; every means or method suggested to accomplish this end should receive due consideration from those in charge, for if the machines are not producing, money is not being made.

Points to Consider When Laying Out a Tool Room

To lay out a new or to rearrange or remodel an old tool room there are seven cardinal steps to be considered, which are as follows:

A systematic classification of all tools used in the shop, as previously given.

A logical arrangement of the racks, cabinets, etc., in the tool room in accordance with the classification, as shown in Fig. 63, locating those sections used the most nearest to the window for issuing and receiving tools. Main rack sections arranged so as to assure the proper distribution of light, utilizing floor and wall and space to the best advantage, so as to permit easy access to all points without retracing steps.

Future additions and elasticity of rearrangement when conditions may require.

A sufficient stock of all tools to meet the requirements.

Means for proper maintenance provided.

A proper checking system should be installed so that the entire stock in the tool room may be represented either by tools or by checks, the checks accounting for and designating the location of the tools in the machine shop, forge shop, grinding department or elsewhere.

An individual hook or peg should be provided for each individual tool, to hold the checks, and should be constructed and placed as to render the checks secure against being knocked off.

Description of the Apparatus

This is a system of units permitting innumerable combinations. The main rack is constructed on the unit system; sections can be added when and where they are required, their addition necessitating no changes in the arrangement of the existing racks. The racks follow a definite standard, their compartments measuring 24⅝ inches square and 17 inches deep. They should be constructed of the best-quality lumber planed on both sides, mortised and sufficiently strong to withstand the strain from heavy tools.

The boxes, trays, and cabinets should be constructed on the unit plan, should be substantially made to withstand long service and are used to subdivide the compartments of the racks into various combinations of sizes. The standard dimensions of the boxes and trays are given in the following table, the cabinets being described and shown in photos V and W.

Outside dimensions of box No. 1, 24x24 inches by any depth under 17 inches.

Outside dimensions of box No. 2, 24x12 inches by any depth under 17 inches.

Outside dimensions of box No. 3, 24x8 inches by any depth under 17 inches.

Outside dimensions of box No. 4, 24x6 inches by any depth under 17 inches.

Outside dimensions of box No. 5, 24x4 inches by any depth under 17 inches.

Outside dimensions of box No. 6, 12x12 inches by any depth under 17 inches.

Outside dimensions of box No. 7, 12x8 inches by any depth under 17 inches.

Outside dimensions of box No. 8, 12x6 inches by any depth under 17 inches.

Outside dimensions of box No. 9, 12x4 inches by any depth under 17 inches.

Outside dimensions of box No. 10, 8x8 inches by any depth under 17 inches.

Outside dimensions of box No. 11, 8x6 inches by any depth under 17 inches.

Outside dimensions of box No. 12, 8x4 inches by any depth under 17 inches.

Outside dimensions of box No. 13, 6x6 inches by any depth under 17 inches.

Outside dimensions of box No. 14, 6x4 inches by any depth under 17 inches.

Outside dimensions of box No. 15, 4x4 inches by any depth under 17 inches.

These subdivisions make any arrangement of the rack compartment very easy and permit a quick rearrangement to suit changed conditions. As the business grows, the elasticity of the system becomes apparent and its two features of easy extension and ready rearrangement of tools become invaluable. The accompanying photographs will give a comprehensive idea of the arrangement and construction.

Checking System

Before any workman can secure tools from the tool room, he is furnished with a number of brass checks on which is

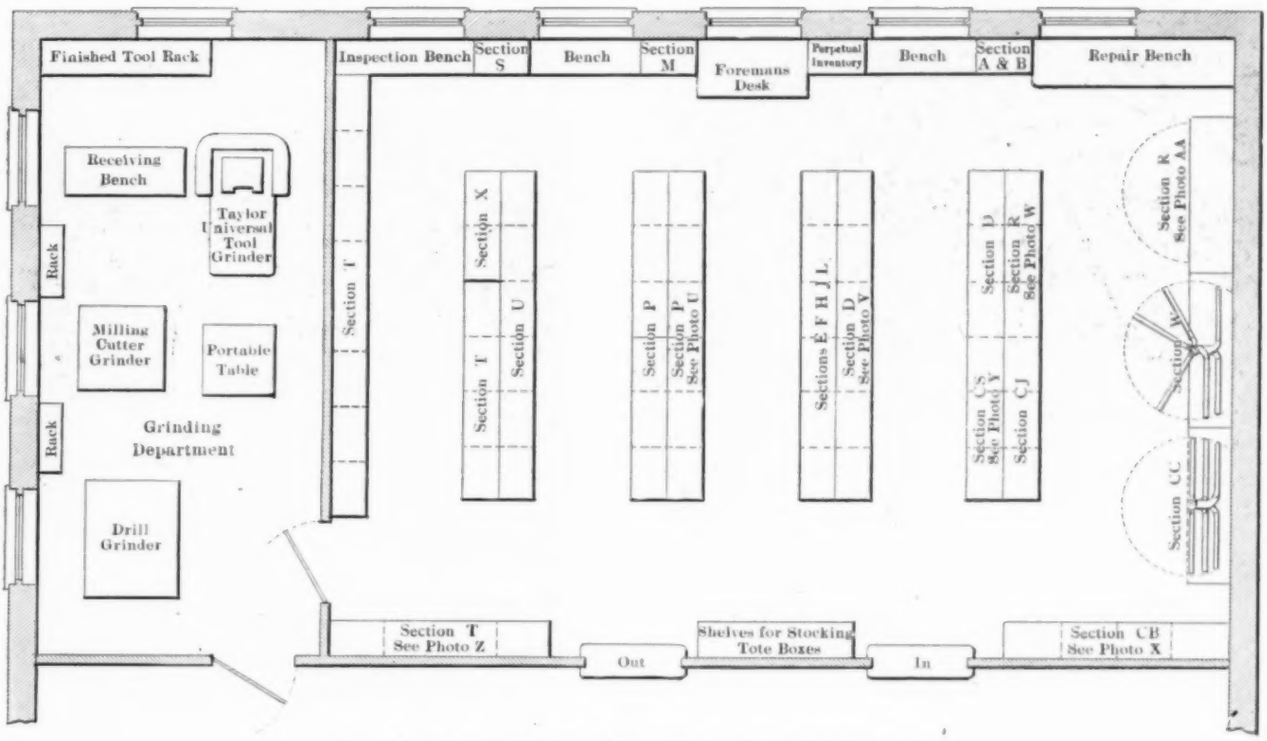


FIG. 63. ARRANGEMENT OF TOOL STORAGE AND GRINDING ROOM

stamped his shop number. When a workman is assigned a tool, he gives his check for it; before the tool is removed from its box, drawer or rack, the workman's check is hung on a pin or hook especially provided for that particular tool as an equivalent for the tool, and, as the check bears the man's number, its exact location in the shop is determined before the tool leaves the tool room.

When the tool is returned by the workman to the tool room, he gives his number, which must correspond to the number stamped on the check, otherwise his check will be withheld until an investigation can be made. This eliminates the possibility of one man stealing another man's tools and receiving credit for them on their return to the tool room.

When the workman's check is removed from the hook, the tool called for must be its equivalent, or another tool-room check which designates that the tool has been sent to the forge shop, grinding department or elsewhere, must be placed on the hook. In this instance the tool is placed in a receptacle for transportation to the forge shop, grinding department, or elsewhere for repairs; on its return to the tool room after being put in first-class condition and inspected, it is replaced in its respective rack or box and the check is taken up.

This method of checking tools saves time, prevents mistakes, corrects forgetfulness, avoids confusion, positively indicates the whereabouts of the tool and is simpler and more efficient than are the various systems requiring the double or single types of checking boards.

Advantages of Systematic Tool-room Arrangement

The arrangement and method of operating a tool room in accordance with the Taylor system facilitate rapid handling of the tools both in assigning and distributing and provide means of knowing what tools are carried in stock without making a detailed search of the tool room. This is accomplished by classification and sub-classification of the tools, by arranging the tool room accordingly and by a perpetual inventory giving the exact number and kind of tools which comprise the entire tool-room stock. The whole scheme is so simple that anyone knowing the alphabet can locate the tools.

The main sections are identified by a letter, as shown in Fig. 63, selected from the general classification of tools. This system defines the class of tools contained in each section. The subdivisions of the compartments of the racks are accomplished by means of the boxes and trays, each being labeled with a brass plate on which is stamped the symbol and size of the tools contained therein, which correspond to the symbols on the sub-classification sheets.

A perpetual inventory is kept of all tools contained in the tool room, which shows the number and value of the stock on hand. This applies to tools regularly carried in stock. When tools are damaged, they are immediately ordered replaced so that the stock may be kept up to a standard. In case tools become obsolete and it is desirable not to replace them or they are ready to be scrapped, they are disposed of and written off the inventory. In case of additions they are added to the inventory.

The inventory is contained in a cabinet fitted in one of the compartments of the racks and is so indexed that by referring to the general classification of tools to find the symbol, you can instantly turn to the sheet required and read the exact number of the tools in stock. To prove this, you can go to the proper section, locate the tool by the symbol on the box and count the number of tools contained therein plus the number of checks for outstanding tools; the sum should be that given in the inventory. The inventory is posted by the tool-room attendants or by the man in charge.

PHOTO W. SECTION "E. F. H. J. L." TOOL RACKS

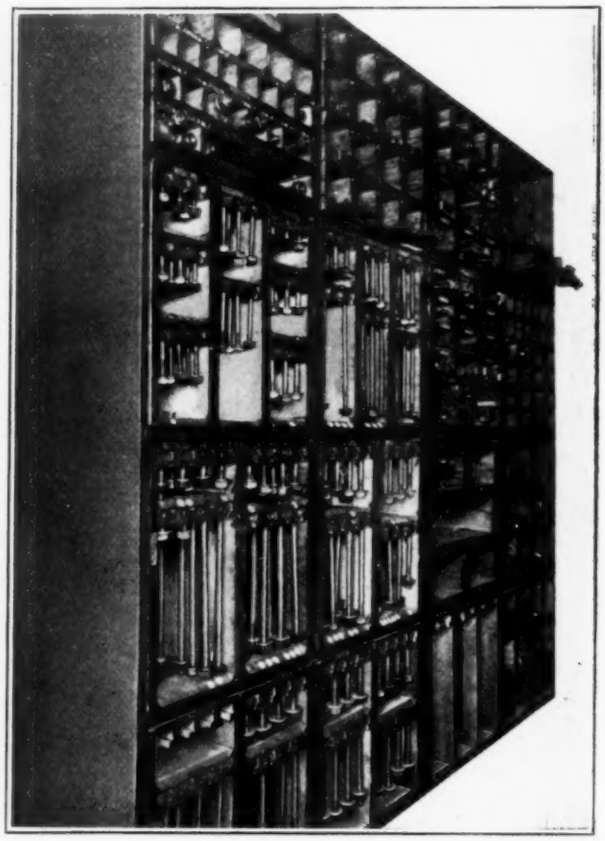


PHOTO X. SECTION "C B" FOR BOLTS, ETC.

Installation of a Tool-room System

Owing to the multiplicity of duties which fall upon the only man or men in the average shop who are competent to inaugurate and install such a system as we have described, the error is generally made by those in charge of placing the tool-room arrangement in the hands of an inexperienced, unmethodical, incompetent

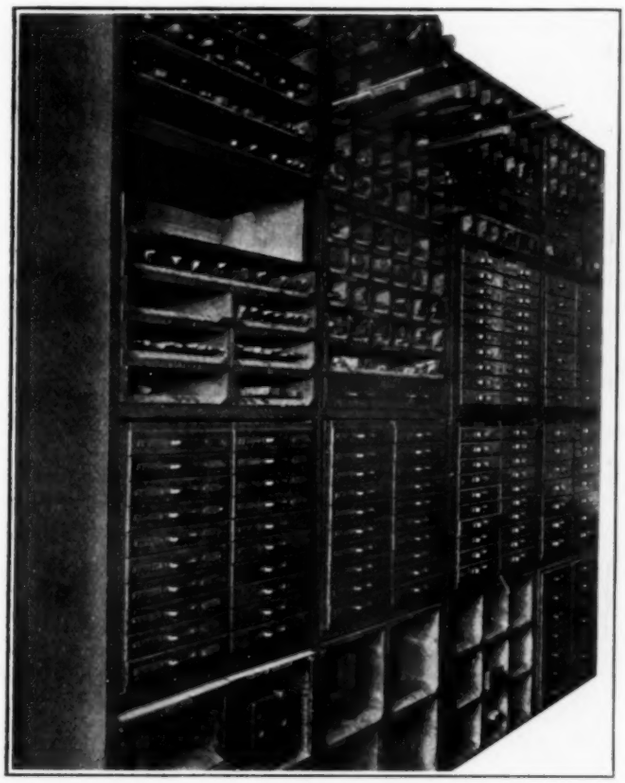


PHOTO V. SECTION "D" TRAYS

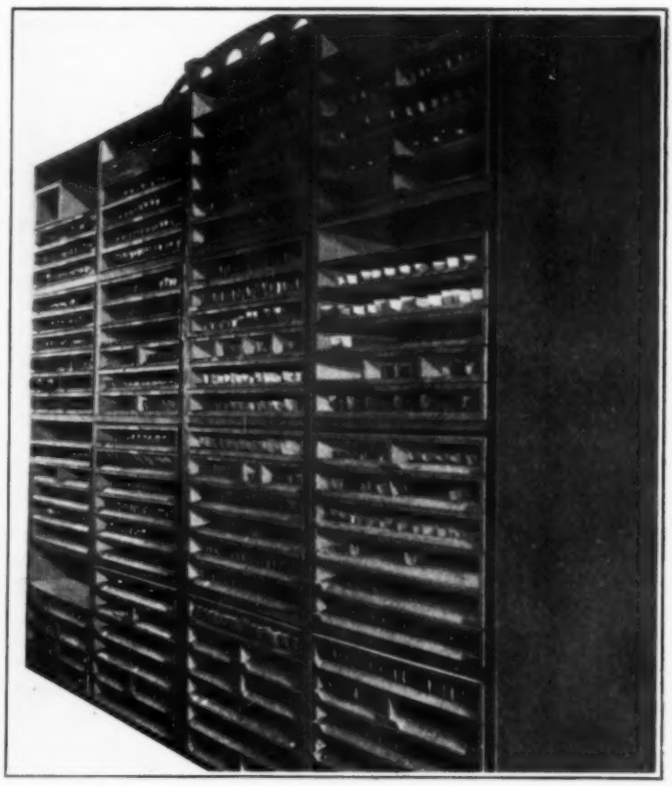


PHOTO U. SECTION "P" OF RACKS AND BOXES

PHOTO Y. SECTION "C S" OF TOOL ROOM

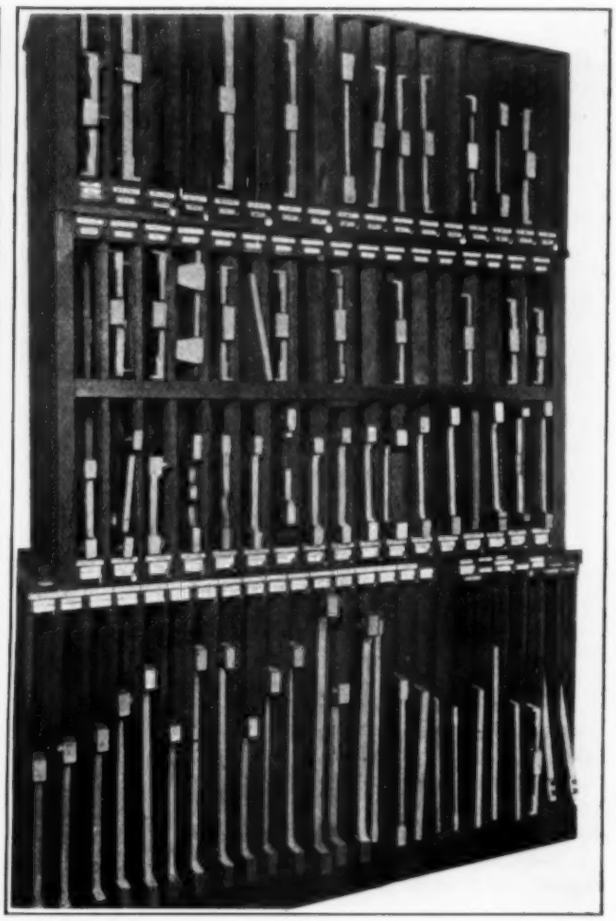


PHOTO Z. SECTION "T" DRILL JIGS

and low-salaried man; as a natural consequence, the results are always unsatisfactory and ofttimes disastrous.

To those contemplating installing a complete system for arranging a tool room, my advice would be, secure the services of an expert who is capable of analyzing the existing conditions and who has had sufficient experience to work out a system suiting the conditions and to overcome the obstacles usually encountered when this is undertaken.

FIG. 63. PLAN OF TOOL-ROOM ARRANGEMENT

The floor space occupied by this plan is 25x50 feet and is so arranged that it will accommodate a supply of tools and a department to grind them sufficient to meet the requirements of an average shop employing, say, 100 machinists; there are provisions for additional storage to allow it to grow without disturbing the arrangement until it will supply the requirements of a shop employing 300 machinists.

Photo U shows section *P*, made up of tiers of racks, each compartment subdivided with trays 24x4, 24x6, 12x4, and 4x4 inches, each complete in itself, labeled with brass plates giving the symbol and the size of the tool contained therein. The front edge of each tray's base is beveled; from this surface project pegs, located in front of each tool, on which a check, designating the tool's whereabouts, is hung when the tool is removed.

Photo V gives section *D*, made up of tiers of racks, each compartment subdivided with trays, boxes and cabinets, each complete in itself and labeled with brass plates giving the size and symbol of the tools contained therein. Seven compartments are shown subdivided with cabinets containing two rows of drawers, each drawer subdivided into compartments for holding a number of the same size drills and provision made for holding the workman's checks for each size drill.

Photo W shows sections *E, F, H, J, L* and part of *R*, made up of tiers of racks whose compartments are subdivided with trays, boxes and cabinets, each complete in itself and labeled with brass plates giving the size and symbol of the tools contained therein. Several of the compartments are subdivided with cabinets whose drawers are the full width and are used to stock milling cutters, provision being made for receiving the workman's checks on the inside of the drawers. These drawers are mounted on rollers.

Photo X shows section *C B*, made up of tiers of racks; each compartment is subdivided with boxes labeled with brass plates giving the size and symbol of the bolts contained therein. Particular attention is called to the method of stocking the bolts; the size and length of the bolts regulate the sizes of the boxes. Pegs are provided on the front of the bottom beveled edge for the workman's checks.

Photo Y shows section *C S*, made up of racks, each compartment subdivided with boxes, each complete in itself and labeled with a brass plate giving the size and symbol of the blocks contained therein. Pegs are provided on the front of the bottom beveled edge for the workman's checks. To the left of the photo are shown the perpetual-inventory files.

Photo Z shows section *T*, made up of racks and subdivided by partitions; the dimensions of the compartments for this type of rack depend upon the size and shape of jigs and fixtures which they are to contain. Each division containing a fixture is labeled with a brass plate giving the size and symbol of the fixture contained therein. A hook is provided to hold the workman's checks. The standard racks are used for jigs and fixtures which can be contained in the standard boxes and trays.

Photo A A shows section *R*, made up of a swinging-door cabinet containing six doors which swing in and out, giving twelve surfaces for stocking tools. This arrangement facilitates handling and permits stocking the greatest number of tools for the floor space occupied. The tools are carried on screw hooks; beneath each hook is placed a brass plate giving the size and symbol of the tool, and in close proximity to the plate is located the check hook for carrying the workman's check. Classes *C C* and *W* are stocked in the same manner.

Photo A B shows sliding-door racks for stocking class *R, W* and *C C* tools. Each hook, labeled with a brass plate giving the size and symbol of the tool, in close proximity to the plate, is the check hook for carrying the workman's check. These doors serve the same purpose as the swinging-door cabinets. They are set up in groups of six with 12 inches space between each door; by mounted wheels they travel in and out on a track, and are held in an upright position by overhead guides similar to any sliding-door equipment.

Undoubtedly the most frequent source of the cracking of aluminum castings is, says *The Brass World*, overheating or "burning" the aluminum while melted. There are several rules that must be firmly obeyed in making aluminum castings, and they are: To melt the aluminum with a slow fire, so that the top of the metal will not become "burnt" before the remainder of the metal is melted; to avoid overheating the metal after it has once melted; to pack the ingots in the crucible as compactly as possible, so that portions will not stick up and become exposed to the action of the flame; and last, but not least, is one which should be posted so that it actually becomes a rule of the shop—*Do not have the aluminum melted before the mold is ready.* This is one of the most common sources of trouble.

Hardening Methods of a Large Shop

BY C. R. CLAVER

I have recently been engaged in a line of work that has taken me to every department of a plant employing 4000 men. My first work brought me in contact with the foreman of the hardening department; during my stay with him, which lasted for several days, I became acquainted with what he is up against. This hardening room does the work for 175 toolmakers and machinists, and 16 die makers; it is surely a busy department. After getting somewhat acquainted, I asked the hardener if it was a hard thing to give every tool just the desired treatment. He at once told me that it was not, under the existing conditions. The work was brought to the hardening department but once a day, which enabled him to operate on a certain class of steel when his fires were at the proper heat for that steel. He had 23 different makes and 58 different grades of steel.

I was informed that the greater the variety of tools being made the greater variety of steels there would be needed. This was new to me, as I thought all good makes of steel were used for most any purpose, whereas he stated that one make of steel might make a good milling cutter but a poor tap. So he showed me a list that comprised 500 different tools and parts of machines. Each tool carried a certain per cent. of carbon and each piece had some particular method of hardening or tempering.

Some were pack-hardened, others case-hardened; some were heated to a lower heat than others; some were heated to 760 degrees Centigrade. This he told me was the result of years of experience. I found that they used a great deal of high-speed steel of several different makes.

STEELS DIFFER GREATLY

He informed me that there was as much difference in the makes of high-speed steel as of carbon steel. Some high-speed steels were used for lathe tools, while others were used for drills, taps and reamers, others for milling cutters, etc. He informed me that, for a tap or reamer to be of the best possible use, it must be a steel that will withstand a severe shock without breaking. Here he showed me some obsolete reamers that had been returned to be annealed. Taking one of these and placing it in a U-shaped clamp, he sprung it 3/8 inch, or enough so that when it was put on centers it ran out nearly 1/64 inch; he assured me that it was hard all the way through.

I presume he saw the doubtful look in my eyes, for he broke the reamer to convince me that it was hard to the center. Then he brought out a reamer of another make of high-speed steel and, put-

ting this in the clamp, told me to notice how easily this make of steel would break. Before he had scarcely got the tension on this one, it flew like glass. He said it required the patience of Job to straighten a reamer made of this steel.

Using Up Old Dies

By this time the man hardening the dies began to get ready to take out his work, which consisted of drop-hammer and blanking dies. The first die showed a seam in the side, and I was told that this die was made of larger dies that had become too small for their original use. They had then been forged to the smaller sizes, being sure to have one side of the die clear of seams to use for the face. A die is seldom lost on account of the seams, and this with a 14-cent steel which carries from 70 to 80 points carbon.

From here we went to the lead bath. This, my friend claimed, made the company more money than any furnace in the hardening room, which fact he explained in the following manner. This fire is the only one that can be or is interfered with during the day, the others having their day's work laid out for them in the morning. Then he showed me how easy it was to heat just the part that it was desired to have hard on any and all repair work, and how a tap or reamer could be heated perpendicularly, to get just the desired heat on them, no farther than the cutting edge.

A Quick Hardening Job

While we were standing at the lead bath, in came a boy with a milling cutter that had a rush order with it. He took this, placed it on a peculiarly bent rod, plunged it in the lead and hardened it. Taking it directly to the oil-tempering fire (his thermometer registering 430 degrees Fahrenheit), the job was heated, hardened and tempered in less than two minutes by my watch.

He knew the prejudice against the lead bath, but said:

"Now let's see what we can find about the lead bath to injure steel. We heated that milling cutter nearly as quickly as it was cooled. I have always hardened the thin mills that belong to a gage mill, and of course they are the ones most liable to break. If they will not stand up with the other part of the milling cutter I would surely be in serious trouble. It is impossible to get the work any hotter than the lead is, and if the lead is always at the proper heat, the danger of overheating is not nearly so great in a lead bath as in a charcoal or gas fire.

Why Some Lead Baths Fail

"There are, however, a great many pieces that ought not to be heated in the lead bath. For instance, it would not be policy to try to heat a die weighing a hundred pounds. Much of this prejudice comes from the fact that the majority of lead baths are heated with hard coal or coke. A fire of this kind gets away from the operator and in fact he can scarcely get up to it to see what heat he has, consequently there is lots of the work that is overheated. The lead bath heated with gas or crude oil cannot be beat for general use. In fact I consider it indispensable."

Thinking I would cause him to waver, I asked him how he heated some circular saws that I saw lying by ready to be hardened. To my surprise he told me that he heated them in the lead bath, and that *pure* lead would not stick to a finished surface, providing it was covered with pulverized charcoal and kept clean. His man hardens about 3000 saws a day, 3 inches in diameter by 0.030 thick.

The High-speed Furnace

He then instructed one of his men to light one of the high-speed furnaces; in the course of 40 minutes his fire was what he considered hot enough. For my part, I thought it would be melted and running over the floor before he considered it hot enough. The temperature was 1350 degrees Centigrade, and the furnace could be heated to 1460 degrees Centigrade, if desired.

The first work was some profile cutters. He commenced to put them in and continued until I wondered where he was putting them all. At last he had the entire bottom of the furnace covered with cutters. I asked why he put so many in at one time and was told that in order to get them to the proper heat the furnace should be well filled, thus causing the temperature of the furnace to drop considerably. In this way he got his work to a uniform heat. He also stated that by filling the furnace and causing the temperature to drop, saved them the trouble of pre-heating the high-speed steel. Just as the cutters came to the proper heat, they were taken from the fire and immersed in fish oil, their experience being that fish oil was the best for all tools.

Hardening High-speed Reamers

The next work was some reamers made of high-speed steel. Having a perpendicular furnace heated up, he took one and placed it in the furnace to heat. I thought that he had surely burned the flutes to the center, but after it was taken from the oil it was a nice steel gray color and showed no effects of being in the fire. From here they were put on centers to be straightened. This was done in the usual way, by placing the reamer in a clamp and putting the tension on the high part, then heating and cooling until they were straight.

Next came some very delicate dies from the engraver. These were packed in powdered charcoal in a small cast-iron box, then placed in a gas furnace to heat. They were heated for 2½ hours. Then the operator drew from a hole in the box a small rod that he called a telltale, or the picee that told how hot his work in the box was. After these were heated, he went to a tank and turned on the water, which came in from the end and bottom and stirred the entire tank. The box was turned upside down just over the top of the water, dumping charcoal, dies and all into the tank. Then he raised a box or frame of wire netting that fitted in the tank and picked off his work as nice and bright as when it left the engraver. All extremely delicate work was hardened in this way to prevent discoloring.

Cooling A Composite Die

After this, the operator took from the fire a die for blanking out a piece of sheet iron 24 inches long and 8 inches wide in a kind of half-moon shape. The cutting parts of the die were welded on to a piece of iron. The steel cutting part was about 1¼x1½ inches, while the iron was 1 inch thick and 4 inches wide. He held the iron part of the die in the water for nearly a minute, then plunged the entire die into the tank of water, which was 12 feet deep. This was done in order to cool the bottom just enough so that it would contract with the steel on top of the iron, thus contracting the bottom and top equally and keeping the die straight.

The next work done was some small worm gears made of machine steel. These were packed in crushed bone in a cast-iron box with a cover to it, and sealed with fire clay, making it air tight. Then it was heated for three hours. The operator then drew the box to the front of the fire, taking the work out one piece at a time, and plunging them into water to harden. This bone can be burned for nearly 100 hours, or until it gets white, providing it is sealed air tight when being burned.

From here I went to the many other departments, making inquiries of the different foremen as to how their tools stood up in use. Some of them said that they did not remember any instance where they had any fault to find. I found one man among the entire lot who had at one time been able to find some fault with the tools, but he said that the tools were universally accepted without question.

In reporting on the constantly growing demand for worn-out horseshoes in the Chinese Province of Shantung Vice-Consul Ernest Vollmer gives the following particulars:

One steamer alone in November brought 300 tons of this scrap iron from Hamburg. The market for these worn-out shoes seems to be almost without limit. Chinese iron dealers buy the horseshoes and sell them to knife and tool manufacturers all over the Province. It is claimed by the Chinese that the temper of this class of iron makes it the best obtainable for knives and cutlery and also good for other tools.

Echoes from the Oil Country—Personal Factors of Safety

By W. Osborne

Everyone who "has to make things" knows that very few things can be made like the deacon's wonderful "one-horse shay" that wore so well and was designed so perfectly that it went to pieces so completely that the old gentleman was sitting on a little pile of ruins when the first, last and only break took place.

The most indefinite thing that a designer has to work with is the "factor of safety," for he must make his own and upon his skill in making it depends his success. Not only has he to make it, but he must make one for each job, and often has to make a number for the same job, for no matter how good a one he has at hand and no matter how perfectly it fits on one part of a job it may not be of any use on another part of the same job.

Ansel was a machinist who had picked up the use of drawing tools. One day the boss wanted a record of a job just finished, for fear of the future, and he was told to make a record drawing. After that it was found to be handy to have drawings of the jobs that came with persistence but so far apart that the men were apt to forget the particulars of them, and he had more drawings to make. Without malice aforethought, but with the same general results, in course of time Ansel found that he constituted the "drafting department" of the establishment; before he realized what had befallen him, from having to make drawings of things that had been made, he was having to make drawings of things that it might be desirable to make.

Envying the Draftsman

Did you ever envy the man who had nothing to do but to sit in a nice room and work with nice tools and make a nice drawing? Ansel did. Did you ever sit in the nice room, surrounded by the complicated forms of some of the complicated pieces of a complicated machine, and work and sweat and stew, trying to get measurements so that you could get a correct drawing, and do it within a reasonable length of time, or in what would look like a reasonable length of time to anybody else? Ansel did. Did you ever have a man who knows exactly what kind of a machine he wants to have made but who does not know how to do even freehand sketching, or to express his ideas in correct or mechanical language, or to read a mechanical drawing, stand over you while you do his work? Ansel did. Did you ever wake up in the night time and with the first return of consciousness find that your tired brain was trying to reconcile verbal description, mechanical movements, strengths of materials, cost, weights, possibility of construction, inertia, time, momentum, acceleration, hieroglyphics written in the air with pointing finger or waving hand, and the collections of matches and pins and pasteboard and strings so conveniently contrived to convey great ideas in an "unconventional" manner? Ansel did. Did you ever have the joys, glory and tribulation of building a machine out of material with which you have never had any practical experience, and for a use of which you know only by hearsay, and to be used by men of unknown experience or intelligence? Ansel did. Did you ever envy the man who has to stand criticism from all directions beginning with the "old man" and running on through pattern shop, foundry, blacksmith shop, machine shop and office to the customer, and getting good measure from competitors and from the interested general public? Ansel did; but it is only fair to add that the time that he did it was when he was working in the machine shop and had never had any experience with the realities of the drawing room.

Now he has a private intelligence department of his own, and it is busy trying to get posted as to the uses and abuses which machinery has to stand, the variations in commercial material as found in ordinary use, the cost of production, the ordinary commercial sizes and quality of materials, either rough or manufactured, which can be gotten readily and used economically. There are numbers of other things which this intelligence department of his is trying to find out, and Ansel feels that if it is very successful, and he lives long enough and doesn't lose his reason or his job in the meantime, that by and by he will be in position to have a private set of "factors of safety" which it will be safe for him to use under some of the conditions with which he is most familiar.

Figuring from Wrong Data

The draftsman and designer in a small plant where he is the "whole thing" in that line is apt to have the "figuring" to do for the establishment when it is anything that concerns the shop end of it, and this is how it often works out.

"Ansel, here is a man who wants to know how big an engine it will take to pull wells. He is thinking of mounting one on a truck."

Ansel reaches for a pad and pencil as he asks, "How deep are the wells and what is the size of the tubing and how fast must you pull it?"

He is told that the wells are up to 2400 feet in depth, have 2-inch tubing and the pulling should be 60 feet per minute. He figures the weight of the tubing, sucker rods and fluid and, making a reasonable allowance for friction, finds that a 35-horse-power engine is indicated. This is too large an engine to mount on a truck as desired, and the man goes away. By and by Ansel sees just such a rig gotten up for this same work, and he sees that the engine is not at the most more than 10 horse-power. It is owned by the same man that he did the figuring for. Investigation shows that the ordinary wells are only about a thousand feet deep, and that the man's guess of 60 feet for pulling speed is about twice as high as the material can be handled with safety, while it is expected that the first pulling will be slow and the speed increase as the load becomes lighter, which of course it will do as the tubing is removed. With the occasional deep well the power is generally transmitted through blocks until the load is lightened.

Numbers of such cases have been encountered where the figures were right enough but where a more accurate knowledge of the facts in the case would have produced widely different results. It may be said that he was not responsible for the incomplete or inaccurate data, which is no doubt true, but he has felt that his value either to his firm or to himself would not have been decreased if his knowledge had prevented him from acting on it.

Where Judgment Comes in

Here, then, he finds need of another kind of factor of safety. In looking up his information on cast iron he finds 6 recommended for steady stresses, 15 for varying ones and 20 for shocks, but he does not find a word about the range to be applied to information imparted. In looking up the range of strengths in cast iron he finds that it runs from 20,000 pounds to say 45,000 pounds for tension. He must be indeed a very young and inexperienced designer who does not use some judgment in choosing which of all these values is most suitable for use in the case before him. It might be assumed by the uninformed that a piece of iron with a strength of 45,000 pounds would not break unless it was loaded up to the breaking point; but the man of experience, because of the things which he knows and of the things which he knows that he does not know, uses a factor of safety. His judgment as a guesser determines what it shall be if he is a man of experience. If he is without the experience, he picks one out from one of his books.

When a young and hopeful inventor who has just received his first patent gives you a statement as to how many of the articles it is going to take to keep the world even reasonably well satisfied it is mostly safe to add from two to five ciphers to the right-hand end of your most able-bodied factor of safety before applying it. If you furnish the money to do the manufacturing, you may even then wish that you had added at least one more.

Ansel found out some of these things, and he isn't much of a designer yet, either; neither is he sure that he wants to be.

Manufacture and Tests of Double Ball Bearings

How Chapman Bearings Are Produced by Specialized Tools and High Efficiency from Comparative Tests with Journal Bearings

SPECIAL CORRESPONDENCE

It has been said that the ultimate aim of the engineer is to reduce, or eliminate as far as may be, the element of time in human activities. In working toward the accomplishment of this result, which carries with it the thought of speed, a great deal of ingenuitty has been spent in reducing friction of various kinds, and particularly in reducing the friction of rotating bearings. Among the ball bearings which have been developed is the Chapman double ball bearing, whose trade mark bears the two legends "Positive Revolution" and "No Cross Friction." Its general design is too well known to need description here, but this article will describe and illustrate various processes in the manufacture of this interesting bearing and give the detailed results of a series of simple comparative tests between four of these bearings and four plain soft-metal lined journal bearings. These tests were made expressly for the AMERICAN MACHINIST, and in the presence and at the suggestion of one of its editors. The type of bearings which will be considered are only those which have been developed for power-transmission purposes.

DETAILS OF THE BEARINGS

The first half-tone illustration, Fig. 1, shows a row of seven of these bearings of the standard loose-sleeve type, used for main-line shafting purposes. The smallest is known as the 1-inch size and the largest as the 4-inch size, and they cover all of the ordinary shafting sizes up to 3 15/16 inches in diameter. The parts in front of the row of bearings are from one of the smallest and one of the largest, which have been disassembled.

Fig. 2 shows a typical bearing in section; by referring to it the various parts shown disassembled in Fig. 1 can be more easily recognized. The sleeve *A* is of cast iron and is a free fit on the shaft. It contains several pockets which are filled with graphite to act as an emergency bearing in case through some accident the bearings produced by the balls and their contact surfaces should fail. Tightly wedged to this sleeve are the two cones *B B*; one of these is forced upon a taper turned upon the sleeve itself, while the other is held in place by a circular wedge *C*. The main casting or housing, which is supported by the hanger frame and which carries the ball cups, is indicated by the letter *D*. The ball cups themselves are shown by the letters *E E*. Two dust rings *G G* protect the ball spaces, and the ends of the bearing are finished and protected by the caps *F F*.

Referring now to the section taken at right angles to the axis of the shaft in Fig. 2, it will be seen that between each of the main balls of the bearing is inserted a smaller ball held in a ball cup, which in turn is supported by the main balls. This is the special feature of the Chapman double ball bearing. This spacing cup can be plainly seen among the disassembled parts of the larger bearing, shown in Fig. 1. Fig. 3 shows a recently developed type of shafting bearing known as the compact bearing. The origin of its name is obvious. It uses the same kind of cups

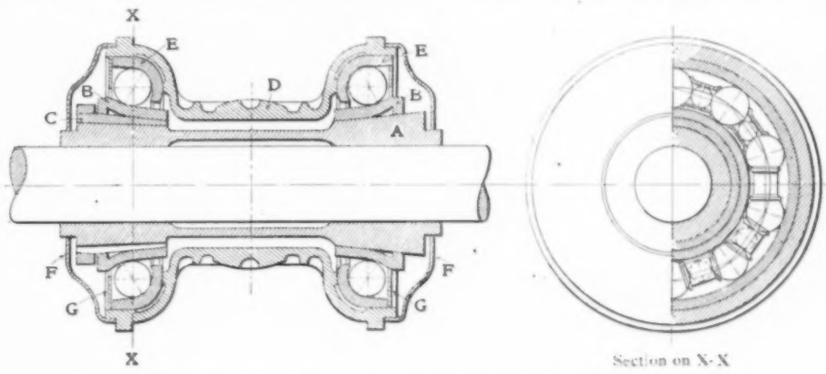


FIG. 2. SECTIONS OF A STANDARD LOOSE-SLEEVE BEARING

FIG. 1. CHAPMAN DOUBLE BALL SHAFTING BEARINGS

and cones as does the standard bearing, but the methods of holding them in the housings and on the sleeves are different. It has been designed primarily in order to give a shorter bearing, one which would not take up much space on the line shaft.

The Balls

Practically all of the balls which are used are imported from Germany. They are of ample size, ranging from ½ inch

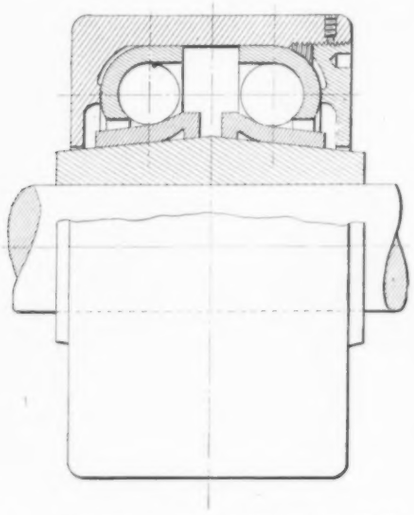


FIG. 3. SECTIONS OF A COMPACT SHAFTING BEARING

in diameter for a 1-inch shafting bearing to 1⅜ inches in diameter for a 4-inch bearing. They are subjected to a most rigid inspection. The first step consists in carefully washing each ball in kerosene or gasolene in order to remove the oil which may be on the surface, then carefully drying it and subjecting the entire surface to a visual examination for scratches or pits or any other imperfections. The balls which do not present a perfect surface under this examination are rejected. Those that pass inspection are then calipered by a micrometer reading to 0.0001 inch. All balls which are more than 0.0008 larger than the nominal size for which they were purchased are rejected. Similarly, all balls which are more than 0.0002 smaller than the nominal size are rejected. Again, all balls which vary more than 0.0001 from being perfectly round are rejected. Finally, the balls which fall within these limits are accurately calipered for diameter and placed in bags containing either 20 or 22, which are the numbers required for different sizes of bearings, and are kept in storage in this manner until used. By this method of inspection the accuracy and character of the balls entering each bearing are controlled. It is interesting to note that a micrometer caliper will

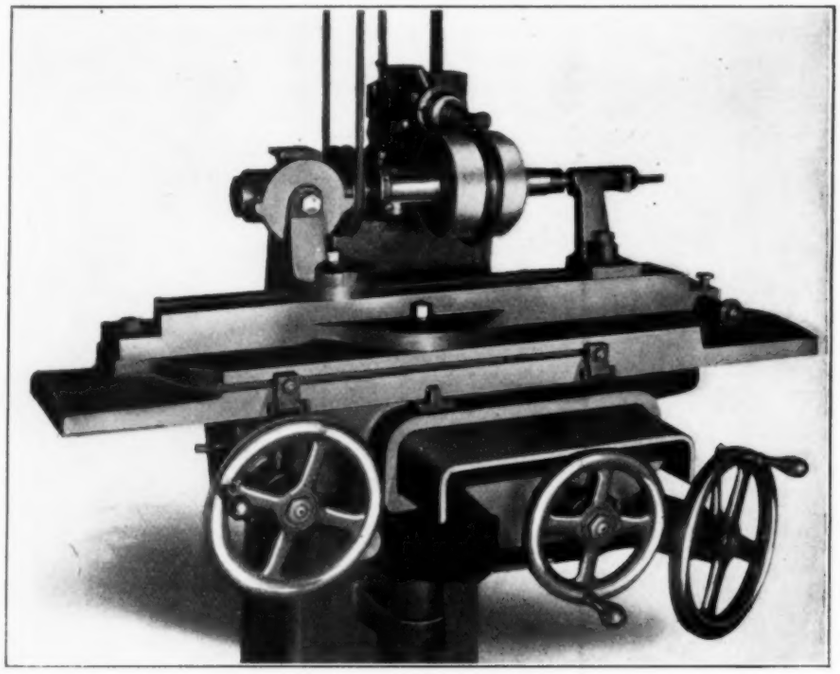


FIG. 5. GRINDING THE BEARING SURFACE OF A BALL-BEARING CONE

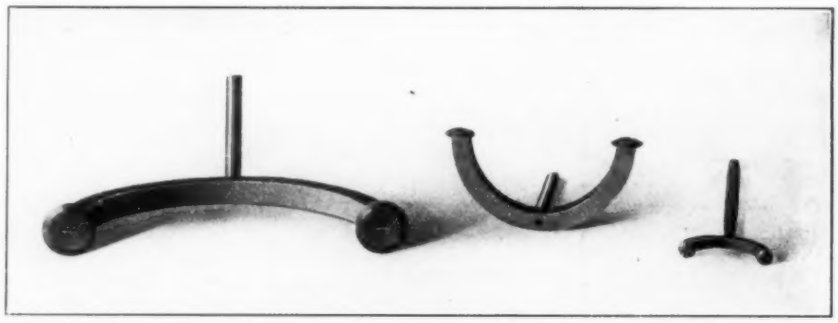


FIG. 6. A GROUP OF GAGES FOR THE BEARING SURFACES OF BALL-BEARING CONES AND CUPS

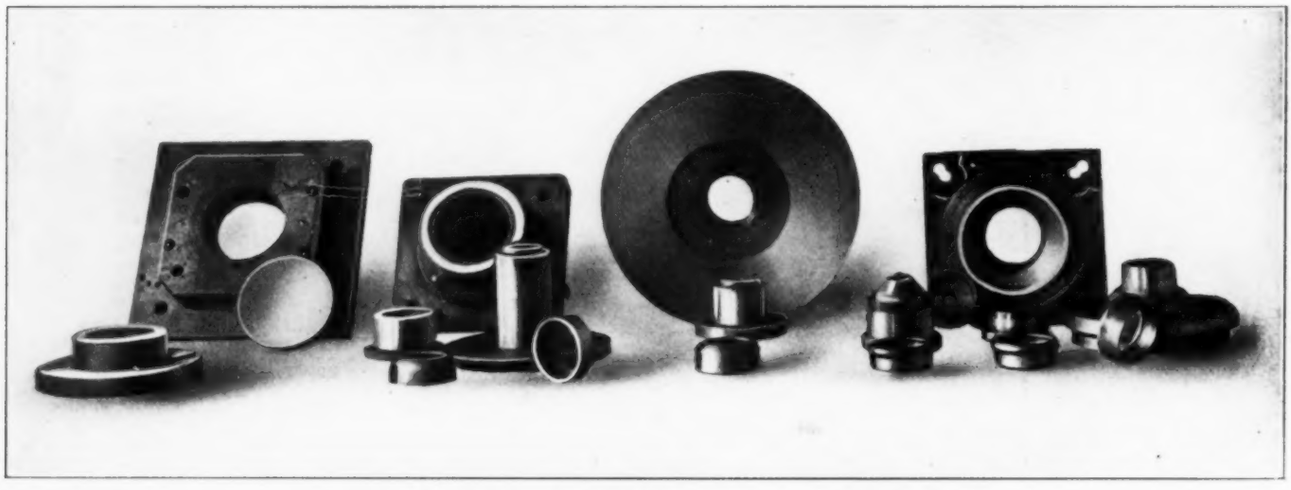


FIG. 4. PRESS TOOLS FOR A 2½- INCH CONE FOR A BALL BEARING

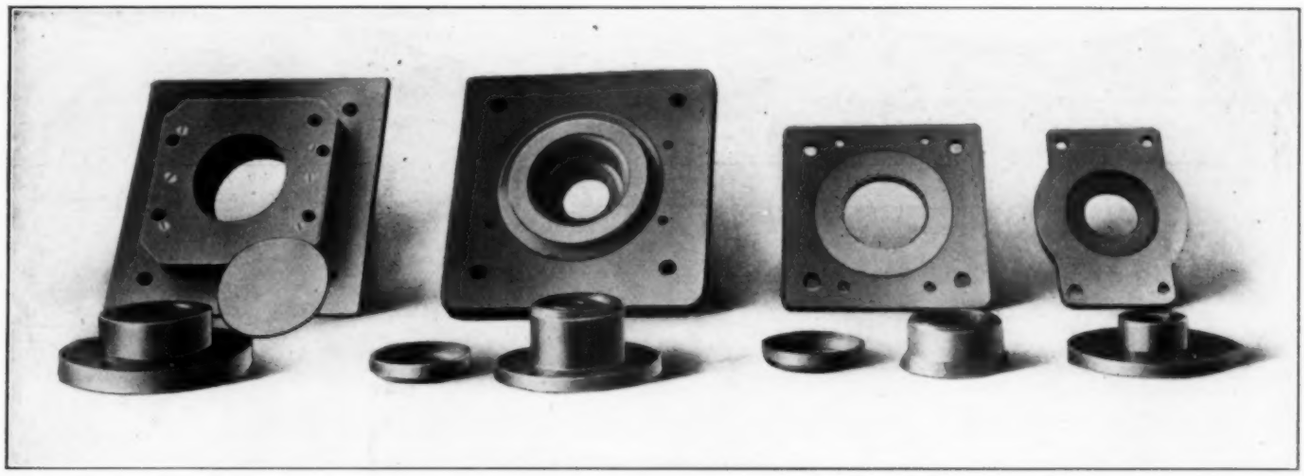


FIG. 7. PRESS TOOLS FOR A BALL-BEARING CUP

lose its accuracy on this inspecting work in less than two weeks, due to the wear of the anvils.

The ball spacing cup is made with a similar degree of accuracy, so that the small ball is a neat fit for its inside diameter; when the cup comes to its proper bearing on the large balls, the smaller ball lies in such a position that a line connecting the centers of the two larger balls passes through its center.

Manufacture of the Cones

Fig. 4 shows the press tools used for making 2½-inch cones. At the extreme left are seen the blanking punch and die with a punched blank resting against the die. The next set of tools punches out the center of this blank and draws it into a finished cone as shown. The next set draws it still more, while the last set, which includes three operations, finishes the cone ready for hardening. All of this press work is done in a heavy back-geared power press. After the press work is completed, the cones are carbonized on the outside for about one-half of their thickness. They are taken from the furnace and allowed to cool and are then reheated in a muffle and dipped in a large tank which is 17 feet deep and which has a constantly circulating supply of cooling water. The depth of this tank is such that the pieces will be perfectly cool before reaching the bottom. A large screen is at the bottom, which catches the pieces as they are dropped, and by means of which they are lifted to the surface. The depth of the tank was determined by experiment in cooling the largest pieces which are handled. After hardening, the cones are ground on a specially rigged grinder shown in Fig. 5. They are carefully ground to a gage; a group is shown by Fig. 6. The disks which form the gaging surfaces are of the same diameter as the balls for which the cones are to be used, and these gages are used both for gaging the external contact surface of the cones and also the internal contact surface of the cups.

Manufacture of the Cups

Fig. 7 shows the press tools for making a 2½-inch cup. As the methods are very similar to those used in making the cones, it is unnecessary to describe them in detail. They are carbonized, re-heated and hardened in the same manner as the cones, and are then taken to grinding machines, shown by Figs. 8 and 9. Fig. 8 shows the process of grinding the outside of the cup, or the surface which bears against the inside of the housings. Fig. 9 shows a grinder specially rigged for grinding the ball contact surface on the inside of the cup. The illustration is very clear and shows the mechanism by which the small grinding wheel is made to travel so that the contact surface is ground on the arc of a circle the radius of which is equal to the ball radius. Several in-

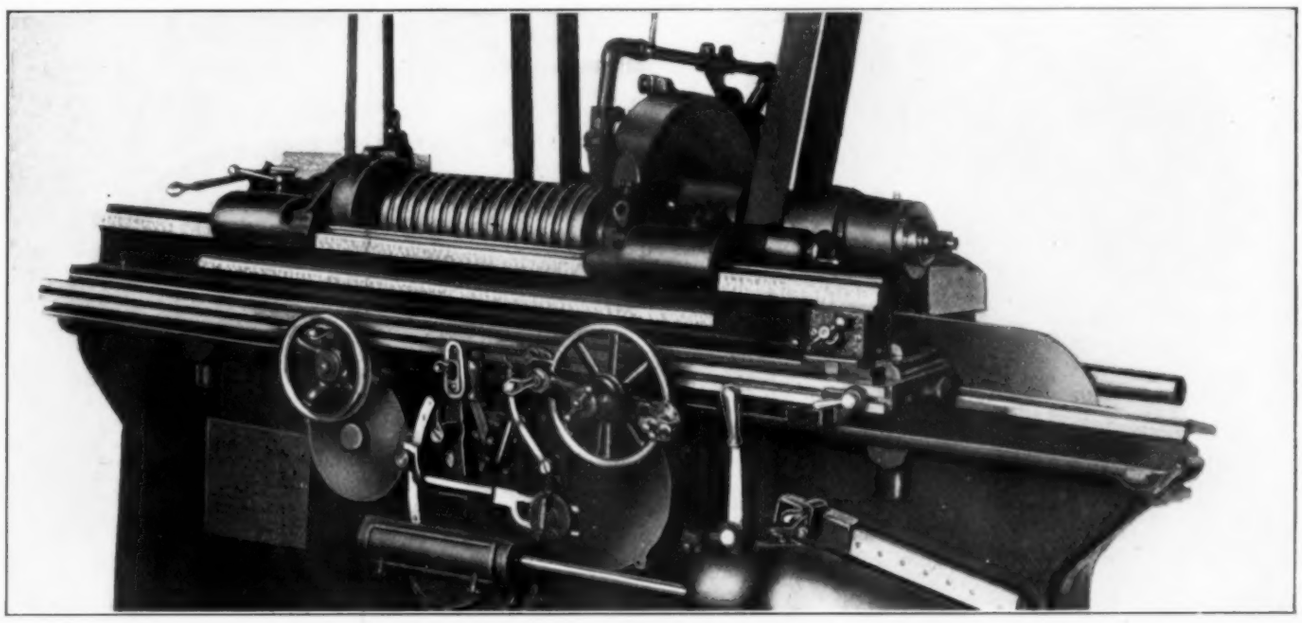


FIG. 8. GRINDING THE OUTSIDE OF A STRING OF CUPS

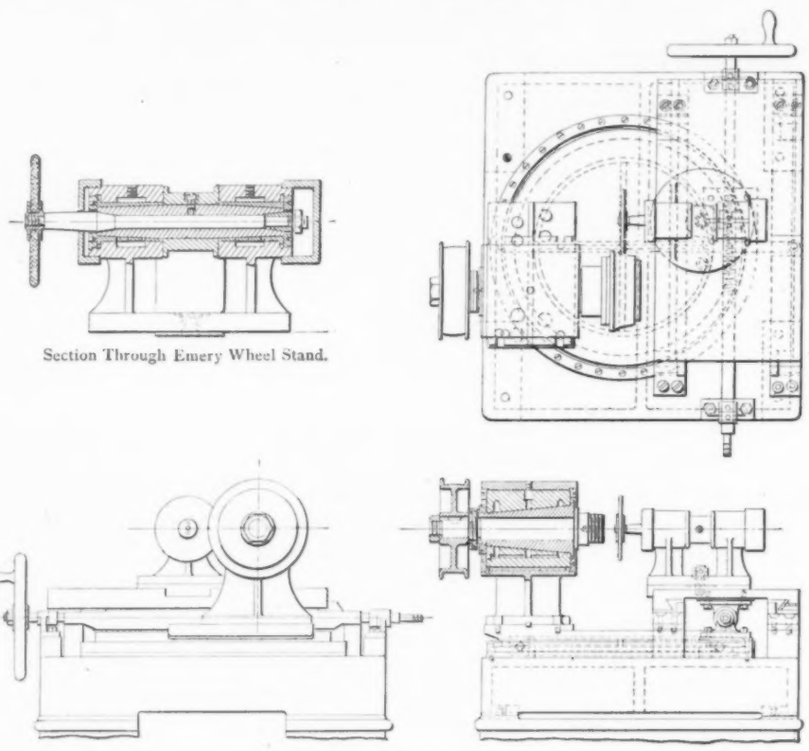
genious mechanisms have been developed for grinding this surface, one of which is shown by the reproduced assembly drawing of Fig. 10. This shows the wheel in position for grinding the outside surface of a cone, although it is obvious that a similar motion would also grind the inside surface of a cup. This assembly drawing, with its attendant sections and details, is so clear that no especial description is necessary.

Manufacture of the Housings

The illustrations, Figs. 11 and 12, show a most interesting special tool for doing the machine work on the bearing housings. This special tool, while performing the function of an expensive turret lathe, is made from a simple lathe by adding a special chuck and two special tool holders. It is a pleasing example of what can be accomplished by using an engine lathe with carefully designed and built special tools necessary to perform the particular operations which are desired. The construction of the special chuck is plainly shown, the casting holder being partially withdrawn. After this is slipped into place it is held by a spanner nut. Motion is given to this chuck by a shaft and gear, shown in the rear on Fig. 12, which are driven by a gear on the lathe spindle. The tool holders, one on each end of the chuck, carry all the tools which are necessary to rough and finish a housing at one cut. These tool carriages are fed from the feed shaft in the same manner as the ordinary lathe carriage. Each special tool holder is provided with a knock-off, which is operated at the end of the cut.

Machining of the Sleeves

Fig. 13 shows another engine lathe, with its special chuck and tool holders, used for machining the sleeve which goes on the shaft and upon which the bearing cones are pressed. This development is very similar to the one for the housings, except that there is a feed for the tools which rough and finish the taper derived from a cam shown at the rear upper corner of the carriage and carried on the gear shaft. The work is held in the revolving chuck in a manner similar to that described for the housings, and both ends are finished at one cut. These special tools were undoubtedly comparatively inexpensive in first cost. They do work accurately, quickly and cheaply, and are an interesting parallel to the highly organized turret lathe of the present, in so far as they apply to the particular operations for which they are designed.



Section Through Emery Wheel Stand.

FIG. 10. ASSEMBLY AND DETAILS OF SPECIAL GRINDING ATTACHMENT FOR CONES

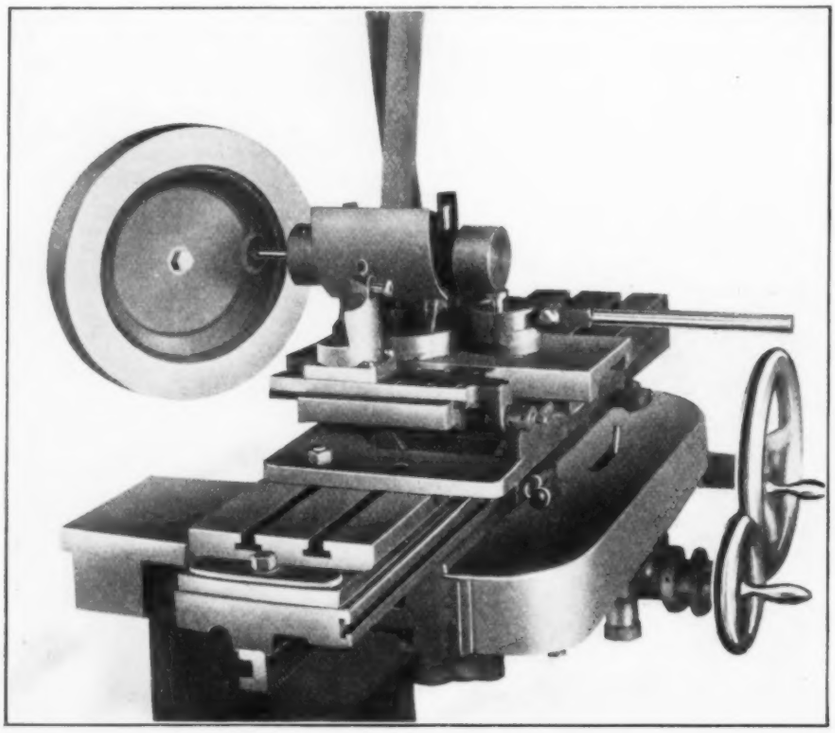


FIG. 9. GRINDING THE BEARING SURFACE OF A BALL-BEARING CUP

Assembling

We have sketched briefly the manufacture of the most important parts of the bearings and now come to the assembling. Fig. 14 shows a hydraulic press, so arranged that the lower platen can be rotated by means of an electric motor. This press is used in forcing the cups into the housings and in forcing the cones onto the sleeves. As we have mentioned, one cone is fastened to the sleeve by means of a taper wedge driven from the outer end. The bearing is completely assembled with the exception of the dust rings and end caps, and is then placed in this press in such a way that pressure is brought upon this cylindrical taper wedge, while the bearing is being rotated by means of the dog shown in position in Fig. 14. Thus the bearing is pressed together evenly and accurately until both sets of cones and cups come into such a position that the balls are locked. The bearing is then reversed, pressure brought upon the end of the sleeve, and it is forced back sufficiently to give a good running adjustment. After the dust rings and end cups are put

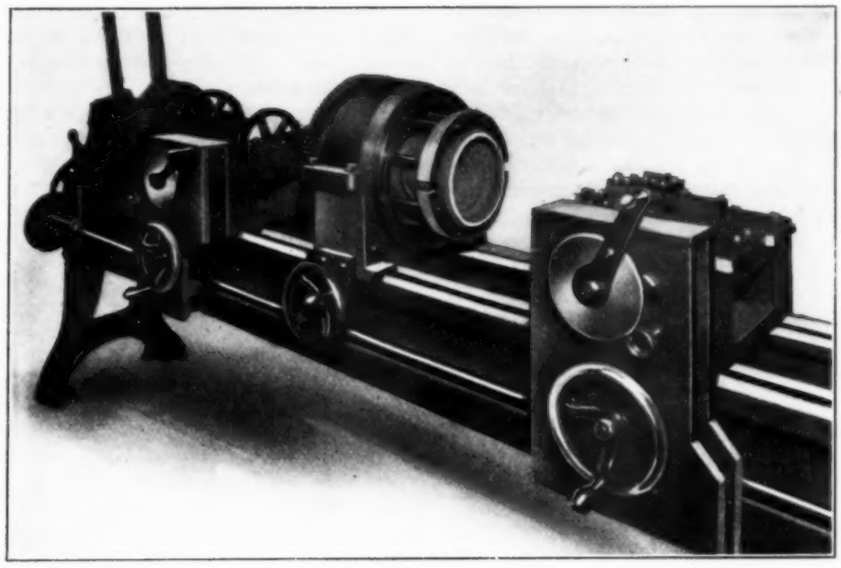


FIG. 11. LATHE FOR TURNING BALL-BEARING HOUSINGS

on, the bearing is ready for the testing floor.

The Testing Floor

Fig. 15 shows a shaft mounted on two heavy floor stands between which is a hydraulic jack so arranged that pressure can be brought upon two bearings which are to be tested at the same time. This device is used for testing the bearings under a heavy load.

A similar arrangement is shown in Fig. 16, except that this is used for the smaller sizes of bearings. With this device the load is applied by means of two steelyards suspended from overhead and arranged with turnbuckles between their hooks and the yokes surrounding the bearings, so that the arms of the steelyards can always be kept horizontal. To this floor all the bearings are sent after assembling, and here they are tested under a condition of loading which is intended to several times exceed the amount which they will receive in actual service. After successfully undergoing this test they are ready for shipment.

Comparative Tests Between Chapman Double Ball Bearings and Babbitted Journal Bearings

The arrangement shown in Fig. 16 was used to obtain a comparative test between the horse-power absorbed by four Chapman bearings applied to a shaft 2 7/16 in diameter and four babbitt-lined journal bearings applied to a shaft of the same diameter. The shaft upon which the journal bearings were installed is shown behind the testing motor. It was intended to run these two shafts under parallel conditions and at speeds of 100, 200, 300, 400 and 500 revolutions. For each speed the load was varied by increments of 100 pounds from zero to 1400. Power was obtained from the motor which is seen in Fig. 16, and which itself is equipped with double ball bearings. This motor was built by the General Electric Company and has practically no bearing friction, as shown by the following letter from its engineering department at West Lynn, Mass., under date of September 11, 1906:

"We are sending you three copies of speed tests and efficiency of the CQ 10-6 H.P.-230 volt-550 r.p.m. shunt motor recently shipped to your factory. The motor was fitted with Chapman double ball bearings designed and built by you. A careful test of this motor shows that the use of these bearings practically eliminated the bearing friction of the motor. This motor had approximately 1.25 per cent. better commercial efficiency than it would have had if fitted with regular oil-ring bearings."

Thus, as regards the test, the motor

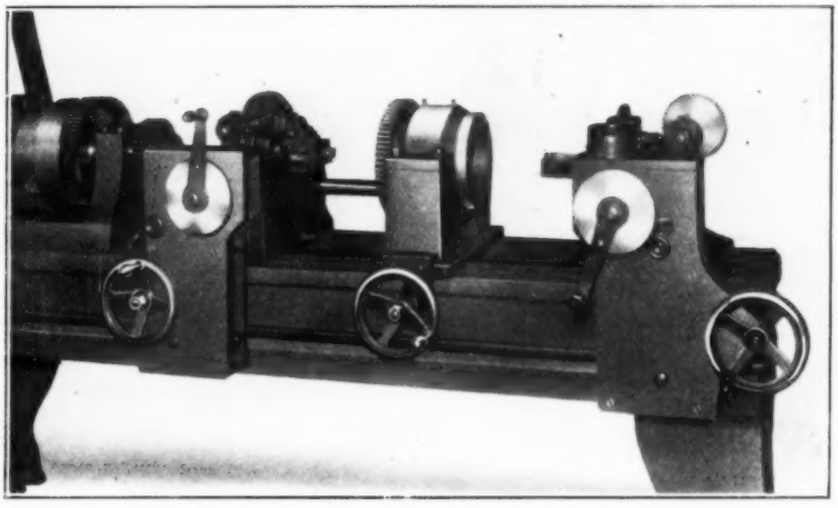


FIG. 13. SPECIAL LATHE FOR MAKING BALL-BEARING SLEEVES

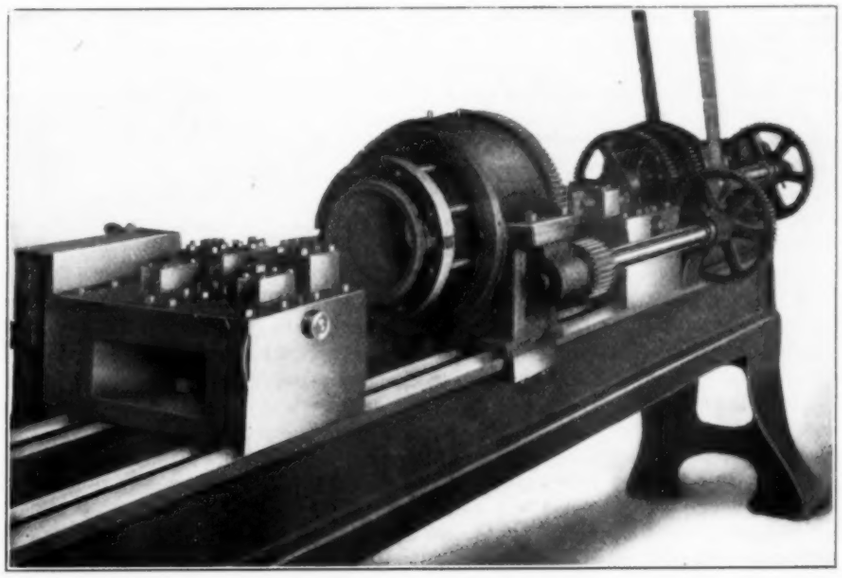


FIG. 12. REAR VIEW OF LATHE FOR TURNING BALL-BEARING HOUSINGS

friction was considered a negligible quantity. The motor had a pulley on each end of its armature shaft. The distances from the center of this shaft to the centers of the two shafts carrying the bearings which were tested were the same. The same pulleys were used in each case for the same speed and the belts were unchanged. Thus the conditions obtaining were exactly parallel for the two sets of bearings. Observations were taken of the current input of the motor and of its voltage. This was corrected for the electrical efficiency of the motor at the various loads in order to obtain the motor output, which is the factor used in plotting the accompanying curves. By this method it was of course impossible to eliminate the friction of the motor, little as it may have been, and the friction of the short driving belt. The influence of this factor would be to the disadvantage of the ball bearings. The distance between centers of the floor stands for each shaft was 32½ inches. The bearings which were loaded were spaced equally between the hangers.

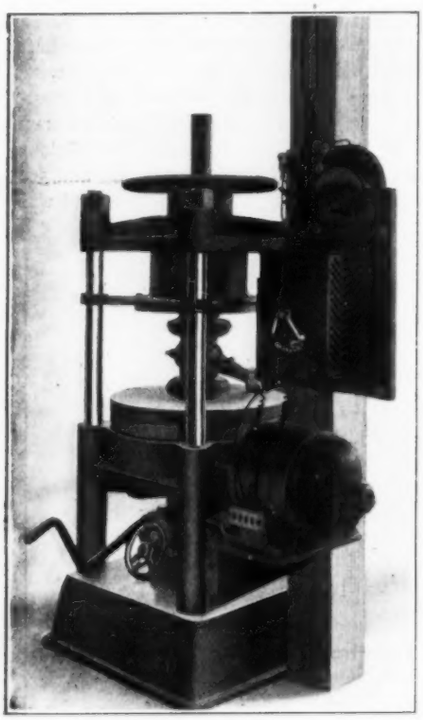


FIG. 14. THE ASSEMBLING PRESS

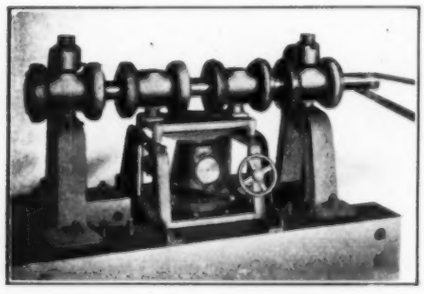


FIG. 15. LOAD-TESTING MACHINE

The Chapman bearings were of the standard loose-sleeve type. The babbitted bearings were 2 7/16 inches in diameter and had a soft-metal lining 9 inches long. They were carefully cleaned just prior to the test and the lubrication was ample. While, of course, these conditions were more like laboratory conditions than paralleling those in actual service, still the results obtained are in perfect comparison. It was impossible to obtain the exact speeds which were desired; the speeds which were actually used and which were uniform for the comparative runs between the two bearings were 123, 215, 321, 421 and 530 revolutions per minute. This fact again tended to the disadvantage of the ball bearings, as the relative efficiency of the babbitted bearing increases with the speed.

The curves shown by Figs. 17 to 22 inclusive were plotted from the results of these tests. A consideration of the curves plotted for the journal bearings shows a drop for the horse-power value at a point of about 100 to 200 pounds load. This was probably due to imperfect lubrication, and after this point had been passed the power curve is quite regular in its outline. There is, however, a considerable increase in the power absorbed as the increased load is applied. As an illustration, in Fig. 19 the low point of the journal bearings' horse-power curve is 0.065, while the high point at 1400 pounds load is 0.225 horse-power. The curve for the ball bearings under the same conditions runs from a low horse-power value of 0.04 to a value of 0.07. Similarly all of the curves for the ball bearings are quite regular in character.

Fig. 22 shows the five curves of saving plotted together. In a general way they show that the Chapman bearing, compared with the journal bearing, is more efficient at heavy loads and at low speeds. This saving varies from about 96 per cent. in the test at 100 revolutions per minute and with 1400 pounds load to about 32 per cent. at 300 revolutions per minute and 100 pounds load.

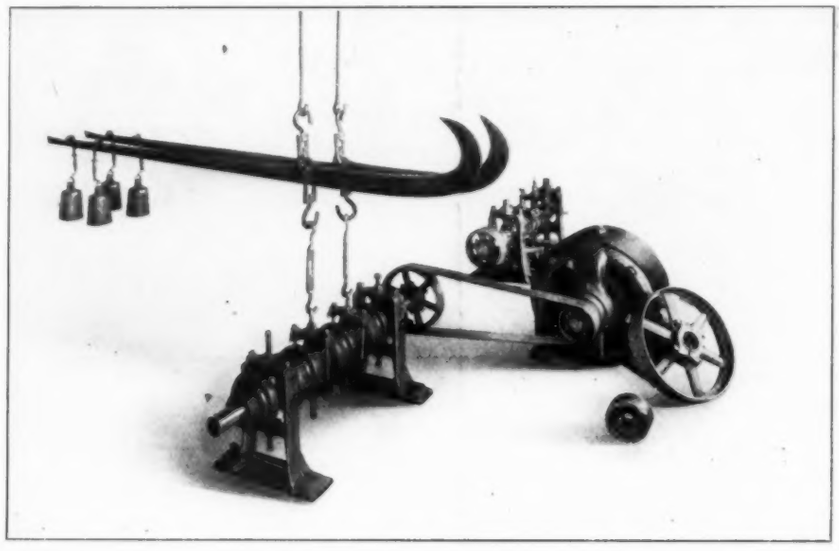


FIG. 16. TESTING MOTOR AND SHAFTS

Treating High-speed Steel

By E. R. Markham

I suppose many a man has tried various methods of treating the new steels, to see if he could not get better results than when they are treated by the regularly prescribed methods. I am sure I have experimented along some lines that, should my friends who are wise in this particular line of work find out, they would think I had gone crazy. Well, a few of the experiments turned out fairly well; the others I don't say much about.

I have for years had as a hobby the pack hardening of carbon steel for many purposes, and I have many friends who have profited by adopting my hobby when treating steel for certain purposes. I am sure that every man who has gone about this treatment in the right way has had good results and could not be persuaded to abandon the method unless someone could show him a better.

Packing in Charred Leather

In conversation with a client who is the superintendent of a manufacturing establishment, I told him, more in jest than in earnest, that I guessed I would try pack hardening some high-speed steel. We both were of the opinion that indifferent results, or no results at all, would follow the experiment. Nevertheless, I placed a piece of the steel in an iron box surrounded by charred leather, placed a cover on the box and sealed around it with fire clay. The box was placed in a furnace, heated to a full yellow heat and allowed

to remain several hours; it was then removed from the box and immediately quenched at this heat in a bath of oil.

When I tested the steel for hardness and strength, I was surprised at the excellent results obtained; the steel was extremely strong, fine grained and hard.

Forming Tools

As I had on hand several flat forming tools of intricate form, made from high-speed steel, which had been sent to me to harden, I decided to harden two of the tools by this method. After they were hardened, I sent them to the owners and requested a trial and a report as to results. In a few days I received as answer: "Tools fine, do so some more with the rest of the tools you have. Our reason for sending these to you in the first place was that we couldn't get any results when we attempted to harden them. We have been hardening high-speed steel for some time with good results, but this steel we could do nothing with. Tell us how you did it."

Today they are pack hardening a great many tools made from this steel. I do not advocate this method for all kinds of steel; neither am I sure that it would work well on large, heavy tools, having never tried it; but I do know that many times small, thin pieces of steel work nicely when hardened this way.

Results Obtained by Others

A few weeks ago I received a letter from an old friend who worked for me nearly five years in a hardening room I was in charge of. He said: "You will remember the method we used to use when hardening steel; you always called it pack hardening. After leaving you I worked in a shop where I hardened thousands of tools such as milling cutters, punch-press dies, taps and screw-cutting dies, as well as gages and similar articles. These I hardened by our old method and methods would result; but, so far as I never lost one. I am now pack-hardening the new steels, and am having fine results, but haven't tried it on any very large pieces as yet, although I am going to some day."

Conclusions

I do not know how speeds as high as are obtained by the regularly prescribed have experimented, we have obtained results that were extremely satisfactory and were enabled to get as high speeds as had ever been employed with similar tools, and the tools stood up much longer than when treated the other way.

I have waited until now before presenting this to the readers of American Machinist, as I have before now tried something that seemed to work well, but which failed to work well when tried again. However, the experiment has been made by several besides myself, and the results obtained were good.

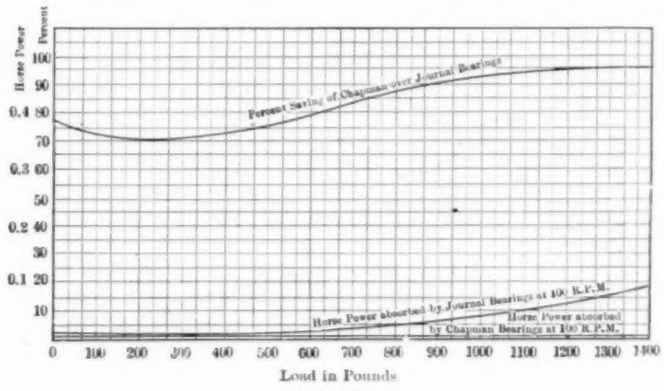

Horse Power
Percent
Percent Saving of Chapman over Journal Bearings
Horse Power absorbed by Journal Bearings at 100 R.P.M.
Horse Power absorbed by Chapman Bearings at 100 R.P.M.
Load in Pounds

FIG. 17

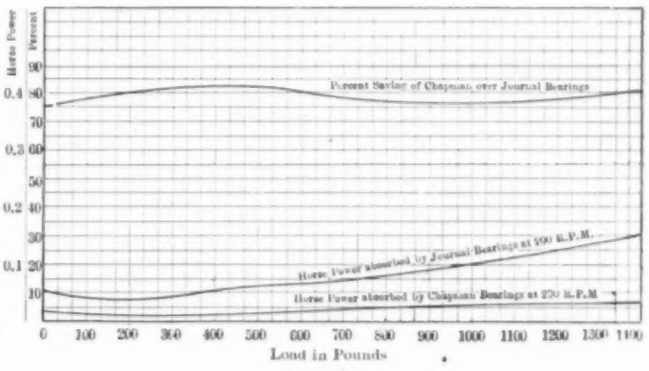

Horse Power
Percent
Percent Saving of Chapman over Journal Bearings
Horse Power absorbed by Journal Bearings at 400 R.P.M.
Horse Power absorbed by Chapman Bearings at 400 R.P.M.
Load in Pounds

FIG. 18

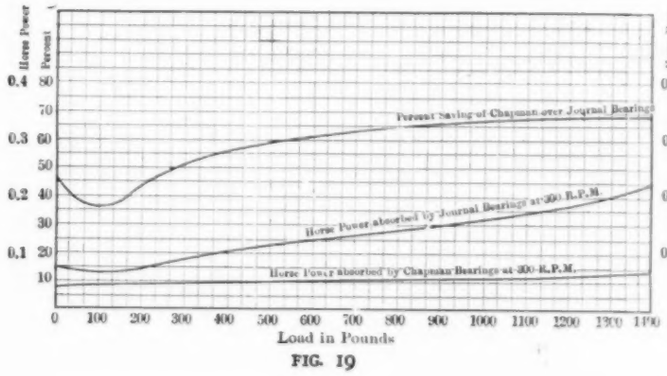

Horse Power
Percent
Percent Saving of Chapman over Journal Bearings
Horse Power absorbed by Journal Bearings at 300 R.P.M.
Horse Power absorbed by Chapman Bearings at 300 R.P.M.
Load in Pounds

FIG. 19

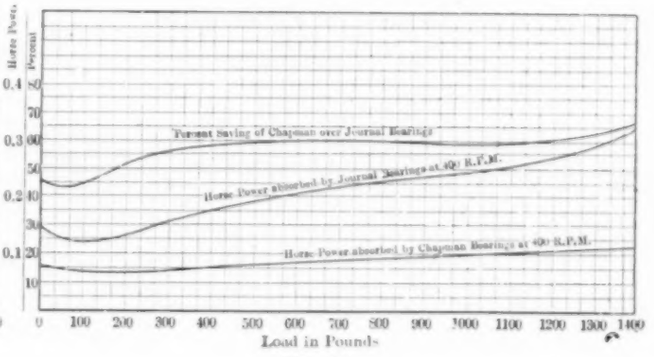

Horse Power
Percent
Percent Saving of Chapman over Journal Bearings
Horse Power absorbed by Journal Bearings at 400 R.P.M.
Horse Power absorbed by Chapman Bearings at 400 R.P.M.
Load in Pounds

FIG. 20

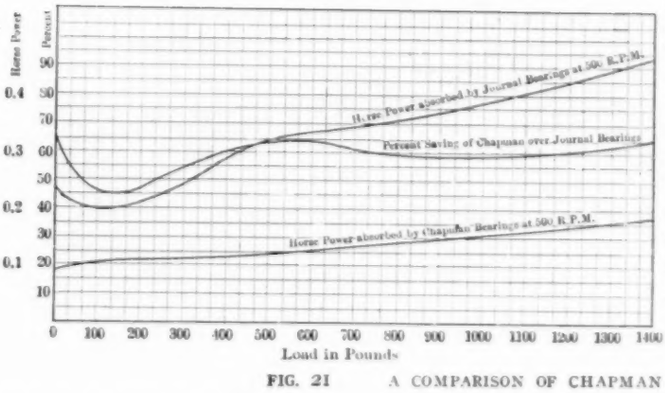

Horse Power
Percent
Horse Power absorbed by Journal Bearings at 500 R.P.M.
Percent Saving of Chapman over Journal Bearings
Horse Power absorbed by Chapman Bearings at 500 R.P.M.
Load in Pounds

FIG. 21

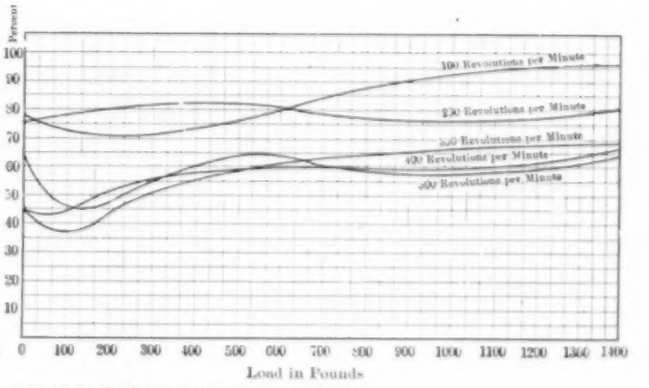


FIG. 22

A COMPARISON OF CHAPMAN AND JOURNAL BEARINGS

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Milling Fixture for Castellated Nuts

Castellated nuts are used to a great extent in automobile construction, and the milling fixture shown by the accompanying cuts was developed to mill these nuts rapidly. Before this fixture was made we had several milling machines constantly at work on this job, and were always behind in production. This condition was the cause of developing this special tool, which completely mills 14 nuts with six cuts.

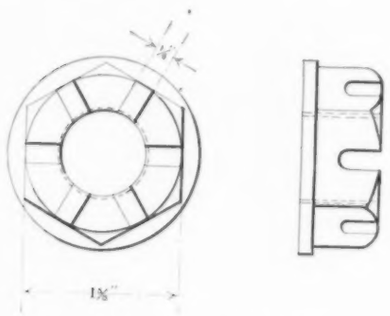


FIG. 1. THE NUT TO BE MILLED

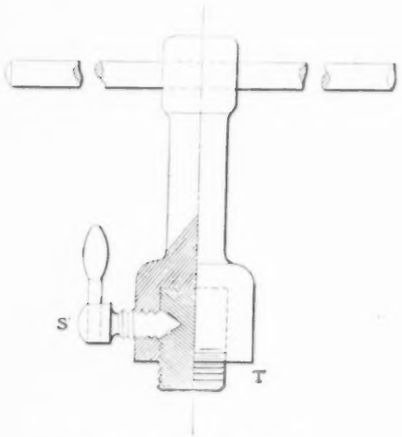


FIG. 4. FIXTURE WRENCH

Referring to the illustration, Fig. 1 shows the nut, which is of the ordinary design. Fig. 2 shows the fixture, in which *A* is the cast-iron base with a tongue and bolt slots to locate and fasten it to the milling-machine table. Central with its figure is the pivot *P*, which is a running fit in the disk holder *B*. The disk holder *B* carries two disks *C C*, each of which has seven threaded studs to hold the nut blanks which are to be milled. The illustration clearly shows how the seven studs are arranged. The disk holder *B* has two positions, 180 degrees apart, and is located and locked by the latch *H*. These two positions are such that when one set of nuts is being slabbed the other is being grooved, and indexing the holder *B* brings the first set of nuts in position for grooving while the second set is in position for slabbing. The periphery of the disks *C C* has 12 hardened-steel bushings with a taper hole to fit the indexing plunger *P'*. In Fig. 2 the left-hand disk is shown with the studs in the proper position for nuts which are to be slabbed with the four slabbing cutters shown at the left of the gang in Fig. 3. Similarly the right-hand disk is properly set for nuts which are to be grooved with the five grooving cutters shown at the right of the gang in Fig. 3. These two positions show the need of the 12 indexing holes in the disks. The screw *S* is used to tighten the brass shoe *F* against the disk *C C* and thus prevent vibration while milling. The wrench shown in Fig. 4 is used to tighten the nut blanks on the studs in the disks. After they are tightened, one-quarter of a turn on the small screw *S'* will relieve the nut from the shoulder *T* so that the wrench can be removed and leave the nut tightly located on the stud in the fixture.

Cleveland, Ohio. PAUL C. HALTER.

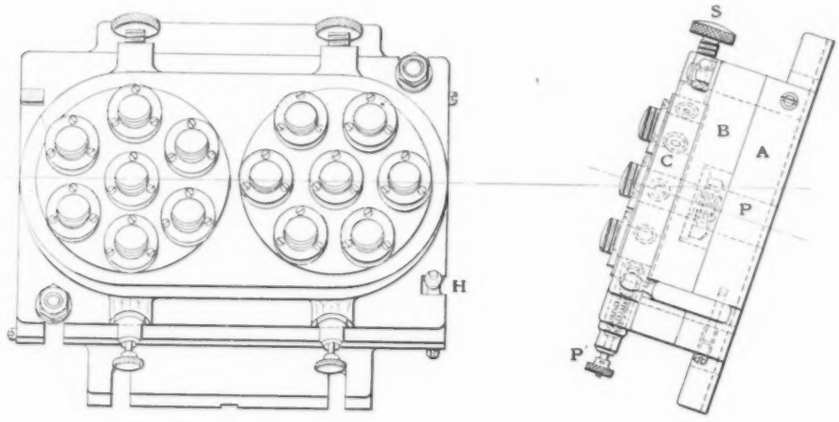


FIG. 2. MILLING FIXTURE FOR CASTELLATED NUTS

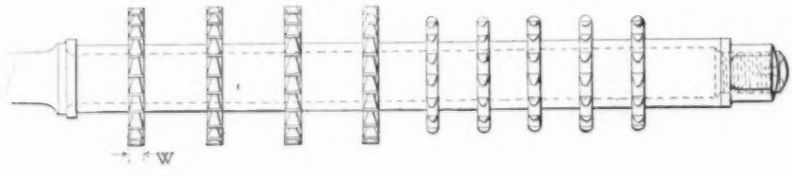


FIG. 3. GANG OF CUTTERS FOR MILLING CASTELLATED NUTS

Short-cut in Drafting

The communication of L. J. Monahan, on page 809 of the AMERICAN MACHINIST, interested me because I have met just such draftsmen as he describes, and also because I have for a long time used his method of inking in and tracing by removing the compass pen for making straight lines.

Some draftsmen seem to think that it is necessary to own, and use, all the instruments in the market applying to their line of work, and waste more time in moving these tools from one side of their board to the other, in order to get at their drawing, than they spend in actual work.

Another thing I have noticed is that many draftsmen cling to laborious methods of drawing which they were compelled to adopt from sheer necessity at the beginning of their career, but which experience should have taught them to abandon for simpler and quicker means of accomplishing the same thing.

As an illustration of the force of habit in this connection, I recall my own experience recently. I was given the job of laying out a dozen or more sets of Brown & Sharpe screw-machine cams; I started

by drawing them out in pencil on bond paper, as is customary in our drawing room, inking them in afterward. It suddenly occurred to me about the time I had completed a couple in this manner that, in penciling the whole cam in, I was wasting time, so I decided to drop the pencil work. The result was entirely satisfactory, and the remainder of the cams were laid out and finished with the pen, with the exception of one pencil operation in each case; that was the describing of an arc used as a construction line.

In this manner nearly one-half the time otherwise necessary was saved, and the sketches were as accurate as it is possible for me to make them with the pencil.

On these cams I went Mr. Monahan one better, by leaving my pen in my compass and merely straightening out the compass to get my straight lines.

W. R. HUMELBAUGH.

Rochester, N. Y.

Patching a Housing in a Hoist Frame

Most people object to a patch job, but there are many patches which make in the end as good a condition as if there had been none and at the same time save money on castings that otherwise would have to be scrapped. When a foreman can get out of bad holes and still have a good mechanical job, he is earning money for his employer and incidentally for himself. Such a job I saw the other day, and the following is a description of it:

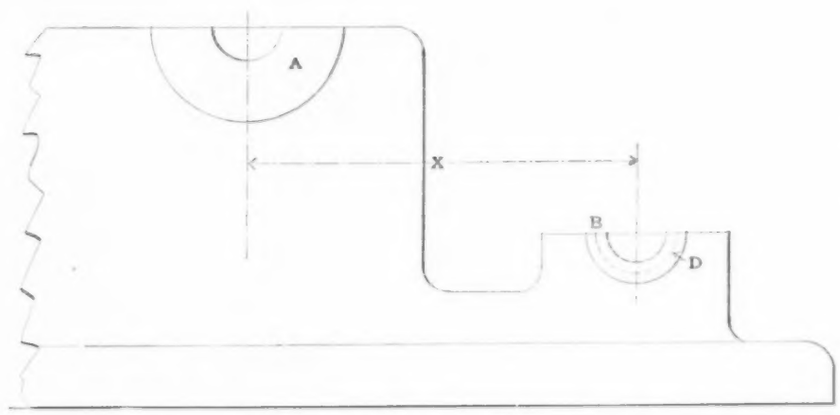


FIG. 1. FRAME CASTING FOR HOIST

Referring to Fig. 1, we have a frame casting for a heavy hoist which carries the main shaft at housing *A* and a countershaft at *B*. The distance *X* is the distance between the center lines of these shafts. After the housings at *A* were bored and the frame was put on the machine for boring the housing *B*, it was found that the casting was badly out—the distance between centers was about $X + \frac{3}{4}$ inch. This meant that the boring tool would hardly touch the housing metal on the side *D*, whereas it would cut most all the metal away from the opposite side. Yet the amount of metal in the housing would not allow us to bore out and put in a sleeve; so finally this scheme was hit upon, which saved about three weeks in time and a 2000-pound casting.

Fig. 2 is an enlarged view of the housing at *B*. On the side *D*, where more metal was required, we drilled and tapped a number of holes as close together as possible; in these we screwed a number of tap bolts, as shown, so that the distance from the casting to the top of the bolt was about an inch.

Next a mandrel was placed in the housings; with the use of a few wood blocks and some clay we soon had the bolts surrounded and covered by babbitt metal. Now our casting was placed upon the boring mill and the bore made. The babbitt served to keep the bolts from turning when the tool was cutting the edge of the bolt head.

It was a perfect patch and gave a good solid support for the bearing, and I think no one will dispute me when I say it was as "good as new" and that the foreman earned his month's salary the day he got out of that hole so nicely.

Braddock, Penn. F. H. WHITNEY.

Why a Planer Should Be Bolted Down

Having read the article at page 957, Vol. 30, Part 2, entitled "Why is a Planer Bolted Down?" written by C. H. Norton, of Worcester Mass., and being interested in the subject, we have tried to show reasons why a planer should be secured to its foundation. It is conceded that we are discussing the subject as relating to modern planers and the advent of high-speed steels. It is a fact that two of the largest and heaviest planers in the works of Gould & Eberhardt, Newark, N. J., one a Chandler 36x36-inch by 20-foot table, and the other a Cincinnati 48x42-inch by 24-foot table, have moved considerably after being placed in position without securing. Of course we can understand that certain bad conditions in the foundation, which would vary in different shops, might tend to promote this sliding; but having favorable conditions, there still seems to be a reason why a planer will creep in the course of time, if the bed is not secured properly to its foundation.

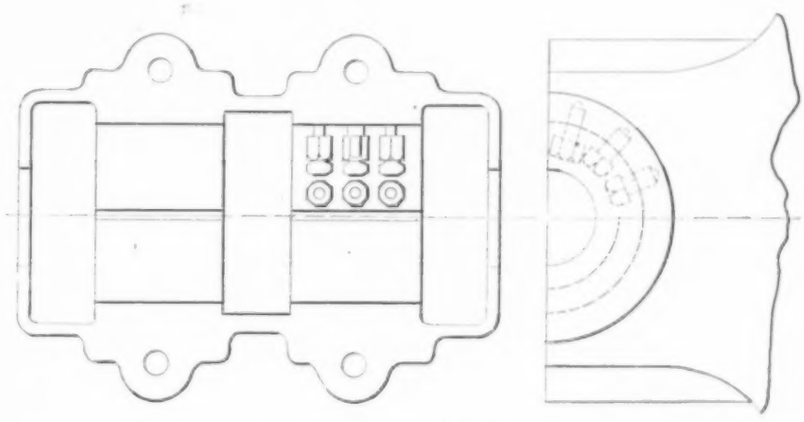


FIG. 2 ENLARGED VIEW OF HOUSING B FIG. 1

Let us first take for an example our Chandler planer, weighing 45,000 pounds. We placed it in position, having it in perfect alinement, June 20, 1907. On October 20, 1907, four months later, we noted the conditions of the bed as to its original position, and found that it had moved 12 inches in the direction of the return stroke. The cutting speed of the table was 50 feet per minute, and 150 feet per minute on the return stroke; that is, a ratio of 3 to 1. Now let us consider the Cincinnati planer, weighing 37,000 pounds. Its cutting speed is 60 feet per minute and the return is 120 feet per minute. This is a ratio of 2 to 1. In the course of four months we have found that this machine moved 4 inches in the direction of the return stroke. It will be noticed that this machine runs slower on the return than the Chandler planer and weighs 8000 pounds less, which accounts for the movement of the bed being of smaller degree.

We can compare this motion of the table, moving upon the ways of the bed, the return stroke being much faster than the cutting stroke, to the motion of an oarsman in a racing shell. The rower, seated upon the moving seat in the boat, would represent the work table of the planer; the tracks upon which the seat slides would represent the ways; and the main body of the boat would represent the bed of the planer. In this case we have the water for a foundation instead of a concrete base. Therefore there is very little friction between the body of the boat and the water upon which it rides. This will consequently serve as a magnified example to illustrate the motion of a planer bed upon its foundation.

The example illustrates how the rower on the quick return stroke, with the sudden change of his body to the opposite direction when the oars take hold of the water, retards the motion of the boat. This retarding motion is due to a rebound, which in turn is due to a change in the direction of the rower's body from the fast return stroke to a motion in the opposite direction. This is one of the recognized difficulties the rower must overcome and is reduced to a minimum only by one skilled in the art.

This "kicking" tendency is also found in the planer table when the motion of that heavy body on the fast return stroke abruptly changes its direction, overcomes its momentum, and starts on its cutting stroke. The rebound causes the bed to move (though ever so slightly) in the direction of the rapid return stroke. Furthermore, the comparison seems logical, for the reason that the two motions, namely, the retarding motion of the shell and the movement of the bed, act in the same direction when compared with the moving bodies which operate upon them.

After having taken the above illustration into consideration, together with the fact that our planers have moved considerably in the course of only four months, there seems good reason for coming to the conclusion that modern high-speed planers with quick return features should be secured to their foundations.

Newark, N. J. H. EZRA EBERHARDT.

C. H. Norton, on page 957, asks a very interesting question and requests readers to tell what they know about this subject: Reasons for bolting down a planer or, for that matter, any other machine tool.

There are reasons; however, none of these reasons is Mr. Norton's fault. Mr. Norton is a shop owner and manager; probably his shop is in every respect as well balanced as his machines, and he, no doubt, sees to it that these important conditions are maintained. Very few shop owners and managers take the same views as he does; neither do all machine-tool builders make machines so well balanced, with such a massive base and with the center of gravity as low as the product of Mr. Norton's shop. My own experience (which extends over more than 20 years) and the experience of others lead me to state the following facts: A well built machine, standing on a good solid foundation, needs no fastening, vertically or horizontally; but general conditions make it necessary to deviate from this ideal practice.

We who are simply hustlers hired to produce the goods are seldom consulted as to the erection of buildings or the selection of machines. We have to take shops as we find them. Most shop owners and managers would decry as absurdities our claims that solid foundations are required for any machine tool of less than 8 or 10 tons weight, and to request adjustable iron foundation plates, solidly embedded, for all machines, would demand considerable courage and would raise questions as to the sanity of the man who proposed such a thing.

Shop floors, principally upper-story floors and ground floors of wood construction, have an unfortunate propensity to get out of level. Take the average machine-shop floor and a number of machines of all makes and of all ages, most of them on legs, and not like Mr. Norton's, with solid box bases, and you have a combination which requires some care. Investigation will show that most of these machines are leveled up by means of wedges. Under one leg ¾- or 1-inch thickness of wedges may be required; under the leg diagonally opposite, nothing may be needed. To try to run these machines without bolting down would mean the risk of finding all these tools trying to simultaneously reach the lowest level in that floor. Add to this the fact that it is often called a waste of time to balance perfectly a piece of work on a machine and that a machine thus running out of balance is subject to a motion which will start it creeping and jumping if it is not fastened to the floor.

Not very long ago I had an interesting experience in this line. I was employed in an executive position by an owner and manager of a shop who told me personally that he considered himself an expert in the business. The shop was built according to his own plans, under his own supervision and from materials selected by himself. It was equipped with a heterogeneous mass of machine tools in various degrees of dilapidation.

My attention was attracted one day by the numerous strips of wood nailed to the framework overhead and close to running belts. On inquiring for the reason of their being there, I was told that the belts would not stay on the pulleys without these strips. On further investigation I found that not a single line shaft or countershaft was either level or in line; that not a single machine tool was level; and the astonishing fact was told me that no attempt had ever been made to set them level when first placed in the shop or afterward, as this was considered a waste of time and quite unnecessary. The line shafts were put up somewhere near level originally; but as the whole building had sagged considerably afterward, it was thought best to leave it alone as long as it would run. The countershafts were put up and twisted until the belts stayed on the pulleys. If this could not be accomplished, a strip of wood was nailed up to make it stay there. Then the machines were placed underneath on the floor, twisted round until the belts ran, and then bolted to the floor. Any reason for bolting them down? Well, I guess so.

The precaution having been taken, when the building was erected, of letting the foundation down a few feet in *terra firma* probably prevented that entire building from creeping; maybe the forces resulting from the motions of the different centers of rotation or oscillation were so well balanced that they counteracted against each other and prevented that building from taking a gyrating or rotating motion around its center of least resistance. I profess I do not know, as I did not investigate anything further. As far as I know, it is still there, out of plumb and out of level, yet still there; and no doubt objects still have the erratic habit of jumping down from tables and shelves in the offices and drafting room on the second floor.

Mr. Norton, however, is right in his view that no bolts nor screws are necessary to hold down in its place any machine, provided: that the machines at all times are running perfectly balanced; that the machines have good solid bases and low centers of gravity (by this is meant that top-heavy machines or those made so by adding special drives or other attachments will be found very unsatisfactory); that the floors are solid, without vibration, reasonably level, and that they will stay so under heavy loads and general running conditions; that the overhead work, including line and countershafts, is level and in line, and will remain so as a unit and individually; that they are rigid, and without vibration under all speeds; that no material, castings nor other articles be stacked or piled up against or very near machines; that no waste oil be allowed to flow or creep under the machines.

The reason why machine-tool builders put holes for bolts or screws in the bases is probably because they know that very few shops are ideal in these respects and that it is often necessary to place a machine tool, principally in some of the rookeries used as shops and factories in most of our large cities, on floors which are anything but level and free from vibration.

I shall anxiously await the opinion of more of your readers.

Philadelphia, Penn. F. C. L. GEORGE.

We have had some experience similar to that mentioned by C. H. Norton on page 957, Vol. 30, Part 2, in respect to the fastening of planers to the floor. About two years ago we moved our shops and at that time installed some new machines. The machines were placed in their proper positions and used immediately.

We began bolting the machines to the floor, starting with the lighter machines, meanwhile noticing if the other machines moved from their positions. We found that we had to fasten the drill presses, milling machines and especially the shaper, for it was true to its shop name, "jumper." It certainly did jump; we had to reset it frequently up to the time we fastened it. The planer and the engine lathes did not creep any, so we put off fastening them; and to this day these machines are still loose on the floor and are standing on their original positions.

The machine shop has a granitoid floor, contrary to the usual custom. We were in doubt if it would be satisfactory, but during the three years we have had no reason to complain against it. This kind of floor might not answer as well as a wooden one in a shop where the finished work has to be laid on the floor, but in a manual-training school it is satisfactory. BERNARD W. NOEL.

St. Louis, Mo.

A New Swindling Game

We believe there is an organized gang of "come on" men working manufacturers and that they should be exposed. A man recently called on one of our representatives and stated he was interested in one of our machines, and that he represented a certain firm in a neighboring city. After examining the catalogs he decided that it was the machine he wanted and gave an informal order for it, which was to be confirmed by the home office. He then found that he did not have quite enough money to pay his return fare and borrowed a few dollars to help him out. It is needless to say that there was no such firm in the city referred to, nor did our agent ever hear of the transaction again.

The same confidence game was repeated a few weeks later at another one of our offices with another representative and by another man. In neither case was the amount secured large enough to bother about, but it is probable that the same scheme was worked on a number of other firms and we think all manufacturers should be prepared to call the patrol wagon should such a man make an appearance.

Chicago, Ill. VICTIM.

A Rod Pointing Tool

It is desirable in screw-machine work to have stock squared off on one end for the purpose of smoother operation and economy of material. It is also desirable to have the other end of the stock cut off at an angle of about 60 degrees so as to protect the chucks and to insure the stock feeding out.

A pipe-threading machine was first fitted with pointing tools in place of the threading dies; but this arrangement did not give satisfaction, as the tools had to be ground incorrectly to break up the chips so that the head would not clog.

The arrangement shown in Fig. 1 is simply a revolving box tool with circular cutters. This is made to screw on the pipe-threading machine spindle and has a speed of 800 revolutions per minute. The body *A* and the bushing plate *E* are made of machinery steel. The bushing plate was made separate so that the T-slot which holds the square nut *F* could be milled out easily. The outside diameter of the bushing *B* is made large enough to allow of various reductions, so that the tool can be easily put in commission for any size of stock it is desired to point. All that is necessary is to screw in the correct bushing and adjust the cutter *C*.

The cutter *C* is placed on at an angle of 3 degrees, so that the cutting edge will have clearance; the edge at *G* is also given 2 degrees clearance so that the tool can be set a little past the center and thus insure a clean cut with no projection from the end of the stock.

The circular tool is set about an eighth of an inch above the center line of the work, as shown in the end view, so that there will be plenty of rake to the part of the cutter rounding the edge of the stock. This is shown better in Fig. 2.

The work *W*, Fig. 2, is shown in the correct position relative to the cutter *C* in the full-line position, there being plenty of rake to the cutting edge. The dotted-line position shows the incorrect position of the work; there is no clearance between the cutter and the work, as both are tangent to the common center line.

An oil hole *H* allows the oil to be brought to the work through the spindle and does away with an outside oil pipe which would be in the way. The fixture is simple and easily adjusted to any size of stock; the cutter for pointing the other end of the stock is not shown, but it is similar to the one shown in position in the drawing.

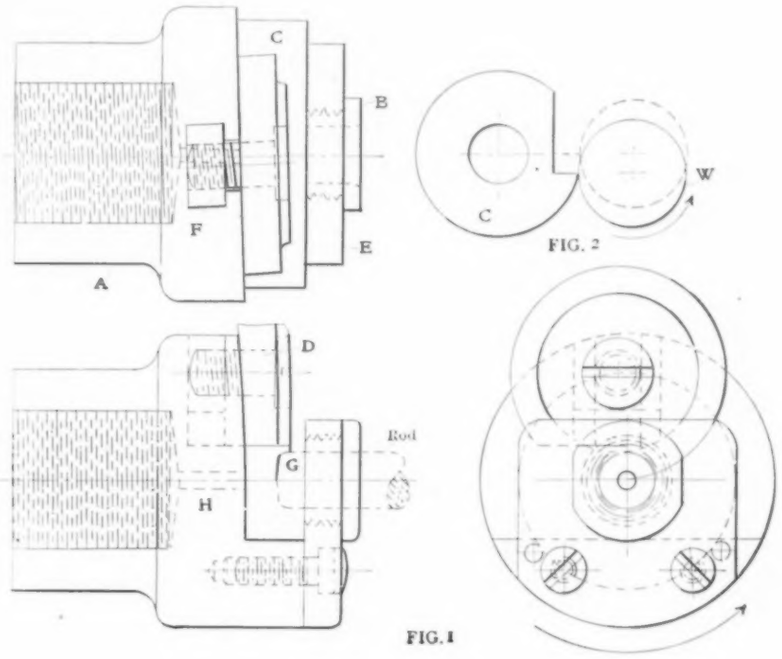


FIG. 1

FIG. 2

A ROD POINTING TOOL

Fort Wayne, Ind. C. C. MASON.

Cutting Threads with Compound Rest

If the right-hand side of the tool is cut away, that is, ground to an angle less than 30 degrees, and the compound rest fed toward the head of the lathe, as would be the case if cutting a right-hand thread, it is evident that the thread on the right-hand side of the tool will be cut to whatever angle the rest is set at, while if the tool is ground to gage, 30 degrees on each side, and the rest set at an angle of 28 degrees, both sides of the tool will cut all the way in and but slight advantage will be gained by using the compound rest.

Cleveland, O. C. H. WELLS.

Removing Broken Taps

Having read T. H. Berg's experience with a broken tap, it brings to my mind a broken-tap incident which happened in our shop. One of our men broke a ¾-inch tap in a steel casting, level with the top of the hole, leaving 2 inches of tap in the hole. We tried several methods to get it out, without success, and at last I suggested drilling down the center of the tap. I got a high-speed drill, found the center of the tap and started up the drilling machine, with some doubts; but my doubts were short lived, for with a few grindings the drill went right through the broken tap, the drill being just large enough to prevent breaking out at the bottom of the flutes of the tap. Once drilled, it was a simple matter to extract the remainder of the tap, which altogether took about 10 minutes from the starting up of the drill to the clearing of the hole, without damaging the thread in the least.

J. SUTHERLAND.

Nottingham, England.

A Register for Press Tools

On page 459 a contributor criticizes Mr. Clerkenwell's article on a register for press tools. Now I have used this same device and it worked exactly as Mr. Clerkenwell has described it. I can assure anyone who is inclined to use this little kink that it is a good one.

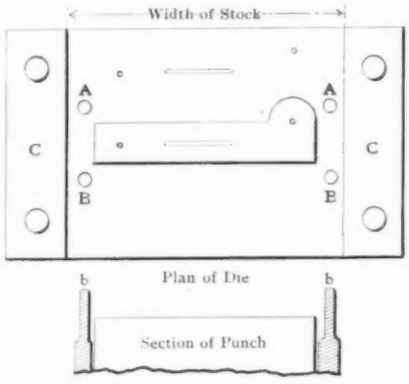
One point of the criticism was in regard to punching a part of a blank in such a manner as not to shear the die. For this purpose a style of press tool called French is ideal. Before power presses were common, the ordinary type of machine was what is known as a hand press, in which the movement of the punch is obtained through a double or very coarse pitched screw by means of a long lever which is provided with heavy weights. The movement of the slide on these machines was naturally rather short, and thus there was considerable trouble from the springing and shearing of the tools. In order to avoid this difficulty, the French type of press tool was developed. Its name is said to have been derived from a Frenchman who first introduced it into England.

There are a few kinks in making tools of this description which it is to one's advantage to know. The punch should be made first and hardened; then the punch plate, guide plate and guide are all sheared with it. Properly made, such a set of tools forms a sort of sub-press die, as the punches fit tightly in the guide plate, which should never be less than one-half inch thick. They are never supposed to be removed from this guide plate after having been once entered. Such tools can be used until the edges are rounded off by the friction of the metal as it is forced through the guide.

L——, England. C. PETITJEAN.

In a former article I showed a successful way of avoiding trouble with small-sized pilots for punches. The system illustrated in the accompanying line engraving is equally successful and may be adapted for almost any size of blanks. It requires a little more stock at the side of the punchings, which of course increases the amount of scrap; but this loss of metal is in most cases counterbalanced by the advantage of the system.

The illustrations show the plan of the die and a section of the punch. Here *A* indicates the location of the piercing punches, *B* the hole for the pilot and *C* the side strips to guide the stock. After the two holes at *A* are punched, the stock is advanced until these holes register with the pilot holes at *B*. The two special pilot punches shown in the section of the punch locate the position of



A REGISTER FOR PRESS TOOLS

the stock exactly, for these pilots extend about one-quarter inch beyond the main punch. When grinding the main punch, it is of course necessary to knock back the pilots a little more than the quarter-inch which they normally project.

A punching die recently made according to this principle has cut 10,000 blanks from one-sixteenth inch brass without regrinding. It is not necessary that the main punch should work through a tight stripping plate, but it is important that the piercing punches and pilot should be a good fit in the stripping plate in order that they may be properly guided.

O. D. CLERKENWELL.

B——, England.

A New Arrangement of a Worm-gear Drive

On page 858 is an article by T. M. Lowthian upon a new English worm-gear drive. It may interest your readers to know that a similar device was made to my designs, for testing purposes, some 18 years ago by the Yale & Towne Manufacturing Company. The original shop drawings and working model are still there. The idea was the same: two worms and wheels, the thrust of the worms received upon a sway beam or pivoted lever of the first order, so that both worms must always share equally the friction and wear of the resisting load.

Stamford, Conn. T. A. WESTON.

Electric Bell and Indicator for Machines

A scarcity of labor caused a manufacturing concern to find itself in a peculiar dilemma. In the machine shop there were six idle planers, three milling machines, four shapers and five lathes. There was only one all-round machine hand to run 18 machines. He could have the assistance of a laborer or floor hand and the most approved hoisting machinery, but how could one man attend to so many machines and not spoil the work? Union or non-union wages and rules did not enter into the problem. There were other employees in great need of machined castings. The superintendent hit upon a novel idea. If a typewriter bell would ring and notify a stenographer when to stop, why could not an electrician attach a larger bell to each machine and notify the machinist when to stop? An electrician was engaged and told to place an electric gong of suitable size in the most suitable place upon each machine.

Adjustable, jointed holders, made of tubing and similar to those used for holding electric lights, were fastened to the side of the planers, shapers and milling machines. In placing these holders upon the lathes, a clamp or thumb screw was found to be preferable. The electric wires passed from the bell through the holders to a push button located upon the end of each holder. The machinist swung this holder around to such a position that when his cutting tool was taking the last desired cut, it came in contact with the button and caused the bell to ring. A numerical indicator, similar to those used in passenger elevators, was also placed in the superintendent's office as a matter of safety. Each machine was given a number to correspond with one upon the indicator.

The more rapidly operated machines, such as lathes and shapers, were provided with an automatic belt shifter. This was made to work automatically by being provided with a spiral spring and a catch or trip. When the bell began to ring, the belt shifter was released and sprang back, thus throwing the belt upon the loose pulley. All this paraphernalia, as some might term it, was really very simple and inexpensive compared with its great value. Now the machinist does not have to hang around one machine for half a day at a time in a listless or drowsy

manner; he can attend to a large number of machines. If more than one bell rings at a time, of course the other machine must stand idle for a short time, unless the foreman or superintendent can look after it. Of course the machinist's salary is apt to increase in proportion to his proficiency and ability to operate more machines and turn out more work.

Oneida, N. Y. ALVIN D. ALLEN.

Starting That Oil Engine

I think the answer to Entropy's question of ethics is simple enough. His neighbor wanted someone to start the engine; he could not do it himself, therefore it was necessary for him to find someone who could. Entropy did so and he was certainly entitled to receive pay for it.

It made no difference whether he was an oil-engine expert or not; he knew enough to remedy the trouble, and that was all that was required. The fact that there was so little the matter with the engine has no bearing on the case, for the defect was sufficient to prevent its working.

We once had a somewhat similar case come to our notice. We were called up on the long-distance 'phone and asked to send a man about 60 miles down to the shore and fix a 12-horse-power gasolene motor that would not start. We did not want to send a man, but they insisted and we sent one down.

He found the only trouble was that they were using too thick cylinder oil; as the weather was very cold, it was so viscid they could not turn the engine fast enough to suck in any gasolene vapor. Our man poured some coal oil into the cylinders to cut the heavy cylinder oil, and the engine started all right.

They did not want to pay for our man's 120-mile trip, because they said he did not do anything. He had made the engine go when they could not.

Philadelphia, Penn. W. ALTON.

A Shaper Fixture

The work for which this fixture was made is shown in Fig. 4, and is a cast-steel saddle of one of the navy-gun sights. The faces *A A A* are finished in the fixture which is shown in Fig. 1 with a saddle in it and a roughing cut being taken.

The fixture consists of the clamps and plate *C*, Fig. 3, and the angle plate *P*, Fig. 2. The plate *C*, Fig. 3, is of cast iron. The face *F*, the hole *H* and the T-slot were finished at one chucking. The faces *A A A* have the hardened-steel plates secured to them and ground to a templet. The clamp studs *S S* and set-screws *E E* are for securing the work in the fixture.

The face *W*, Fig. 4, is finished when the gates are planed off, and is used to work from in all subsequent machining. The set-screws *E E* act opposite to this face and with the pins *F F* locate the work in the fixture. The boss *B* and the plunger explain themselves. The plate *C* is secured to the angle plate *P*, Fig. 2, by the two bolts *V V* and the stud *R*.

The plunger engages the bushings *X, Y, Z*, successively, as the plate *C* is rotated around the stud *R*. To change the cut it is only necessary to loosen the nuts of the stud and bolts, pull out the plunger and revolve the plate *C* until the plunger engages the next bushing. Tighten the nuts and start the cut. A rough cut is taken on all three faces, leaving 0.02 for a finish cut. A 0.02 gage is used to set the tool to the hardened plates *D D D*, and a cigarette paper is used to set the finish cut, making the tool clamp it slightly. The key on the bottom of the angle plate fits a keyway in the table of the shaper, so that it takes very little time to set the fixture.

JOHN J. SEIBERT.

Sparrows Point, Md.

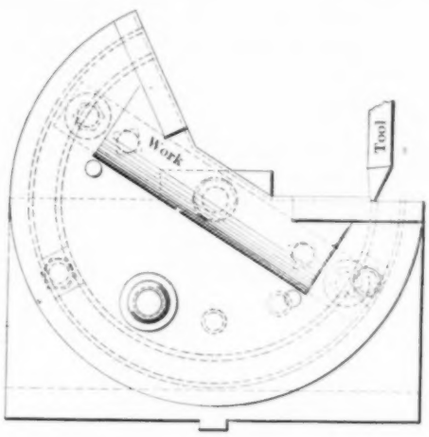


FIG. 1

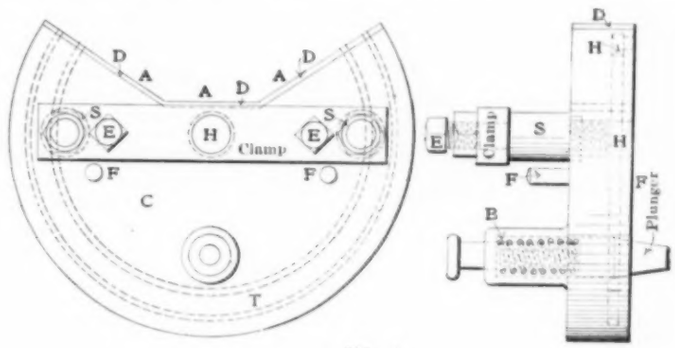


FIG. 3

FIG. 4

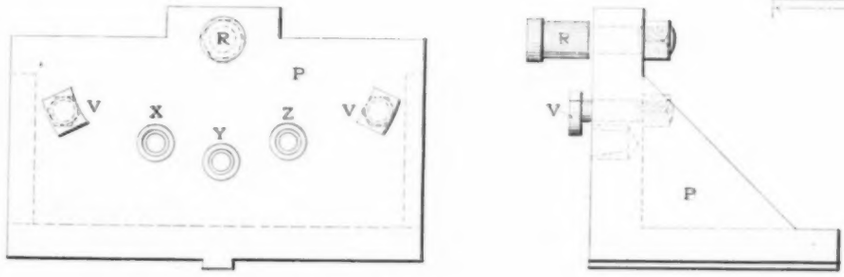


FIG. 2

A SHAPER FIXTURE

A compound for preserving steam boilers has recently been placed on the market at Barcelona and, according to a report from Consul-General Ridgely, it appears to be an improvement. It is claimed that by adding a certain quantity of this preparation to the water tanks all impurities in the water, and matter that might adhere to the sides of the boiler, are at once precipitated.

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Burning Coal without Smoke

The burning of coal without smoke is a question which has been and is being discussed to a great extent, and is one to which managers of industrial plants must give more consideration from the forces of public opinion and city ordinances. A recent bulletin by Professor Breckenridge, of the engineering experiment station of the University of Illinois, is entitled, "How to burn Illinois coal without smoke." It is pointed out that a great deal of study has been given during the last few years to proper conditions for burning coal and to the results which may be obtained from different kinds. Particular mention is made of the work of the Government fuel-testing plant and of the information now available to engineers, in these words: "From a study of the tests of the various coals of the United States, as presented in reports of the United States Geological Survey fuel-testing plant, it seems safe to say that engineers now have sufficient information available to enable them to design boiler furnaces that will burn any coal without smoke. The progress made in this direction during the last five years is surely encouraging, and it is confidently believed that the time will soon come when no power plant can offer as an excuse for a smoky chimney the plea that no appliances are available which can be depended upon for smoke prevention."

The principles of smokeless combustions are well known, yet for several reasons they are not generally applied. It is possible that many believe that smoke cannot be prevented when burning coal under the average boiler of an industrial plant. While unfortunate or imperfect arrangement of boiler, furnace and setting may produce a condition where it is difficult if not impossible to fire coal smokelessly, still conditions can be arranged so that no smoke need be present. Professor Kent, in *Power* for January 7, states: "The first thing to be done to bring about an abolition of the smoke nuisance is to get people to believe that smoke can really be prevented."

Aside from the disagreeable features of the smoke, or the smoke nuisance as it is called, is the important factor of the losses due to smoking chimneys. It is generally and truly believed that there is very little loss in fuel-heating values in the soot discharged from chimneys, even when they are sending forth the blackest of smoke. But the losses caused by the unconsumed gases which accompany the unconsumed soot are far greater in amount. Quoting from the bulletin to which we have referred, "It takes but a small amount of soot to give a dense black color to smoke. If it were to save only these soot particles we could not afford expensive stoker and furnace settings. The appearance of black smoke is fortunately the signal of incomplete combustion, and the losses due to this cause are many times the losses due to the carrying away of the small soot particles."

During the past few years the experiment station of the University of Illinois has operated its boiler plant of about 2000 horse-power without objectionable smoke for 90 per cent. of the time. Over 200 separate boiler tests have been conducted and many varieties of coal have been burned in studying smoke conditions. Summing up the relative importance of boiler and furnace design to give the best conditions for perfect combustion, Professor Breckenridge says. "The opinion of the writer, doubtless held by most engineers, is that the boiler has very little to do with the smoke problem, except perhaps that some types of boilers lend themselves more easily to the necessary furnace construction, which is of the utmost importance when perfect combustion is desired." The article by Professor Kent, to which we have referred, expresses in these words the opinion that there should be a greater distance between the grates and the boiler: ". . . I put myself on record several years ago in favor of a distance of six or eight feet between the boiler and grate for smoky coal. Since that time I have frequently had occasion to lecture or take part in debates on the subject, and I have said that for some Western coals I would recommend 10 feet and for lignites 20 feet, but I have not found anyone with sufficient courage to take my advice." To sum up, briefly, smokelessness can be obtained by perfect combustion, and approximately perfect combustion can be obtained by proper boiler and furnace design and arrangement.

Kelvin Memorial Meeting

On Sunday afternoon, January 12, a memorial meeting was held in the auditorium of the Engineering Societies Building, New York City, under the auspices of the American Institute of Electrical Engineers. Addresses paying tribute to Lord Kelvin and his great work were as follows: "Lord Kelvin As a Man," by the Rev. William T. Manning; "Lord Kelvin as an Electrical Engineer," by Prof. Elihu Thomson; "Lord Kelvin as a Scientist," by Prof. E. L. Nichols; "Lord Kelvin's Work in Submarine Telegraphy," by G.G. Ward, Esq.; "Lord Kelvin in Naval Engineering," by Rear Admiral Geo. W. Melville, U. S. N., and "Lord Kelvin and the American Institute of Electrical Engineers," by T. C. Martin, Esq.

Monthly Meeting of the American Society of Mechanical Engineers *

At the meeting held Tuesday evening, January 14, 1908, the subject "Car Lighting" was presented by R. M. Dixon, and there were in operation several different systems, namely, the Pintsch mantle, the vapor mantle, a new acetylene system and several varieties of axle lighting by electricity with their regulating and governing mechanism.

Mr. Dixon brought out the fact that the Pintsch compressed oil gas system was the most extensively used, it being used on about 80 per cent. of the passenger cars in service, notwithstanding that it is dependent on a stationary supply plant for its light.

Electric lighting is also popular due to its safety, brilliancy and non-heating qualities, also oil gas lighting with proper appliances is equally safe and both gas and gasolene vapor systems excel electricity in brilliancy. In electric lighting three methods are used, one being by a dynamo carried in the baggage car and driven by an engine supplied with steam from the locomotive, the second being by means of storage batteries carried on each car and charged at terminal plants, and the third being with an axle-driven dynamo, the dynamo being mounted on the car truck.

Henry K. Brooks opened the discussion with illustrated diagrams of dynamo control and parts of an electric car-lighting equipment with automatic battery switch regulating apparatus, an automatic polarity reversing switch, brush holders, etc. Some of these were operated showing the method and range of regulation under varying speeds of the train, and how the centrifugal and gravitation forces are utilized.

Matthias Nace Forney

Matthias Nace Forney, engineering journalist, author and widely known mechanical engineer, died at the Hotel Buckingham, New York City, January 14, after a brief illness, aged 73 years.

Mr. Forney was born in Hanover, Penn., and after an ordinary schooling he started his career as an apprentice in the shops of Ross Winans in 1852. On the expiration of his apprenticeship he entered the employ of the Baltimore & Ohio Railroad as a draftsman, serving in that capacity for three years. The prospects of a business career took hold of him at about this time and he spent the next few years in mercantile lines in Baltimore, only to return to railroad work, accepting a position in the machinery department of the Illinois Central Railroad. It was while engaged here that he designed what is known as the "Forney Locomotive." Then his accomplishments as a mechanical engineer became better known.

In 1870, Mr. Forney entered the field of journalism, becoming associate editor of the *Railroad Gazette*, soon afterward purchasing a half interest in the paper. Then came his book, "The Catechism of the Locomotive," which received wide recognition as a highly useful publication for railroad men.

As a member of the Master Car Builders Association he was extremely active in its work and it is due largely to his influence that the association was placed on a firm basis of organization, which has helped it to play such an important part in the standardization of railway equipment. When the narrow-gage mania was spreading Forney forcibly opposed it from the very outset and that it did not come nearer universal adoption is often credited to his efforts.

After a retirement of three years he took up journalistic work again, purchasing and consolidating the *American Railroad Journal* and *Van Nostrand's Engineering Magazine* under the name of *Railroad and Engineering Journal*, which was subsequently changed to the *American Engineer and Railroad Journal*.

As a designer of railway appliances, Mr. Forney held a high place, thirty-three patents standing to his credit, most of which were inventions for the improvement of the locomotive. Attention of the general public was called to Mr. Forney's ability as a mechanical engineer at the time the Manhattan Elevated system was built in New York City, the steam locomotives for use thereon being of his design.

New Publications

TESTS OF INTERNAL COMBUSTION ENGINES ON ALCOHOL FUEL. By Chas. E. Lucke and S. M. Woodward, 89 6x9-inch pages. The Government Printing Office, Washington.

As is well known to those of our readers who are informed on such subjects Professor Lucke has been for some time engaged in a series of experiments on the use of alcohol in internal combustion engines, and this pamphlet, which is Bulletin No. 191 of the Department of Agriculture, gives the details of the tests and the conclusions reached.

The objects of the investigations were to determine whether the gasolene and kerosene engines at present on the American market can run on alcohol as fuel, and to determine as far as possible the improvements which might be desirable in the design of engines manufactured especially for alcohol. Eight engines, some designed for gasolene and some for kerosene, were included in the tests, which are described in considerable detail, although in, comparatively speaking, non-technical language, making the report easily readable to anyone who is fairly well informed on the subject. The tests on each engine are described at considerable length, with half-tone illustrations of the engines and sectional drawings of the parts of immediate interest in connection with the tests, and at the close of the report on each engine appears a summary of the conclusions reached, while at the end of the pamphlet is a general summary of the conclusions.

As regards the adaptability of existing engines to alcohol, the report is more satisfactory than would have been expected. Thus as regards engine No. 1 we read "It also appears that not only did the engine run smoothly with alcohol and, in general, more smoothly than with gasolene, but after a few days' experimenting with the engine, it could be started as well on alcohol as on gasolene. This is directly contrary to many of the foreign reports concerning the difficulty in starting, and which, therefore, seemed to call for heat in the carbureter. In our subsequent tests we found heat to be desirable, but not especialy necessary for starting." Similarly in connection with the test of engine No. 2 we find "The operation of starting the engine was the same whether gasolene or alcohol was used as a fuel and was no more difficult with one fuel than with the other, after the proper fuel valve setting for each had been learned." Similar remarks are made regarding the other engines tested, except in the case of No. 5, which was designed for use with kerosene, and about which we are told, "To run the engine satisfactorily on alcohol, it is necessary that the fuel injection mechanism be slightly modified," although following this we find: "When properly arranged for alcohol this engine can be started as readily and operated as satisfactorily on alcohol as on kerosene." Similar remarks are made regarding other engines.

The economic results were not as satisfactory as the operating results, and regarding the former we are told, "With any good small stationary engine as small a fuel consumption as 0.70 pound of gasolene, or 1.16 pounds of alcohol per brake horse-power may reasonably be expected under favorable conditions. These values corespond to 0.118 and 0.170 gallon respectively, or 0.95 pint of gasolene and 1.36 pints of alcohol." We find no comparison of cost in cents, but our readers will recognize that these figures indicate at present prices, a materially higher fuel cost for alcohol than for gasolene.

The report is of large value and of wide-spread interest and deserves to be in the hands of all who are interested in the subject of alcohol fuel, whether as engineers or as users.

*The paper is printed in full by the American Society of Mechanical Engineers and can be purchased from them for a small sum.

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

A New Surface Grinder

This machine, as shown by Figs. 1, 2 and 3, is intended to cover the field, not only for the class of hardened steel work such as is usually associated with surface grinders, but it is also designed to assist the manufacturer in finishing soft stock. The machine can be used both for roughing and finishing flat surfaces on castings and forgings of all kinds, with a cut varying from 0.0005 inch or less to 0.015 or 0.020 inch in depth, and a cross feed automatically operated at each end of the stroke of the platen ranging from 0 to 1/10 inch wide.

The machine has three especially notable features; namely, the new adjustable tension belt drive, the wheel housing sliding on V-tracks with extensions through apertures in the rear of the bed and the new noiseless friction-clutch reversing mechanism.

Projecting horns or bearings 2, Fig. 2, on the rear bed extend into the interior of the main bed, forming additional support and bearing surface for the wheel housing 5, which also has extended projections 5A which form elongated V-tracks for the housing, and at the same time act as guards to protect the cross-feed tracks when the wheel has been fed back to its limit. It will be noted that the projecting bearings 5A extend out in a position directly under the grinding wheel and that a very long bearing is obtained for the cross feed. By reason of the weight of the cross-feed slide and housing, which approximates 300 pounds, there is no possible danger of its lifting from its track. In fact, it requires a pressure greatly in excess of the weight of the parts to break the contact between the sliding surfaces, this being due to the pressure of air holding the closely fitting slides together.

The vertically adjustable wheel slide 6 is mounted on the housing 5, and is raised or lowered by means of the feed screw 18 and the revolving nut 17, which is operated by the hand-wheel 14 through the medium of beveled gears. The housing 12 which contains these beveled gears can be swung and clamped in any convenient position to suit the operator.

The hand-wheel 14 is graduated on the periphery in thousandths, and the amount of down feed is read by means of the pointer 15, which can be set to correspond with any graduation at the start, being simply clamped around a hub and held by friction.

A combination rod and rack 44 connecting the cross-feed crank is keyed to the cross-feed screw. By swinging the pawl lever to the right or to the left, a feed in either direction can be obtained. It will be seen that, as the cross-feed crank describes nearly a whole revolution at the end of every stroke, and that as it passes above and below the inside center, it must impart a reciprocating motion to the connecting rod rack 44, imparting a like movement to the ratchet pawl and causing the machine to feed in one direction each time the platen is reversed. The longitudinal reversing mechanism requiring but a very slight movement, is operated by strikers on the horizontal bar 47, coming in contact with the swinging lever 32 as it is swung over to its limit. This bar operates the bell crank lever which is connected to the clutch-reversing mechanism through the horizontal shaft.

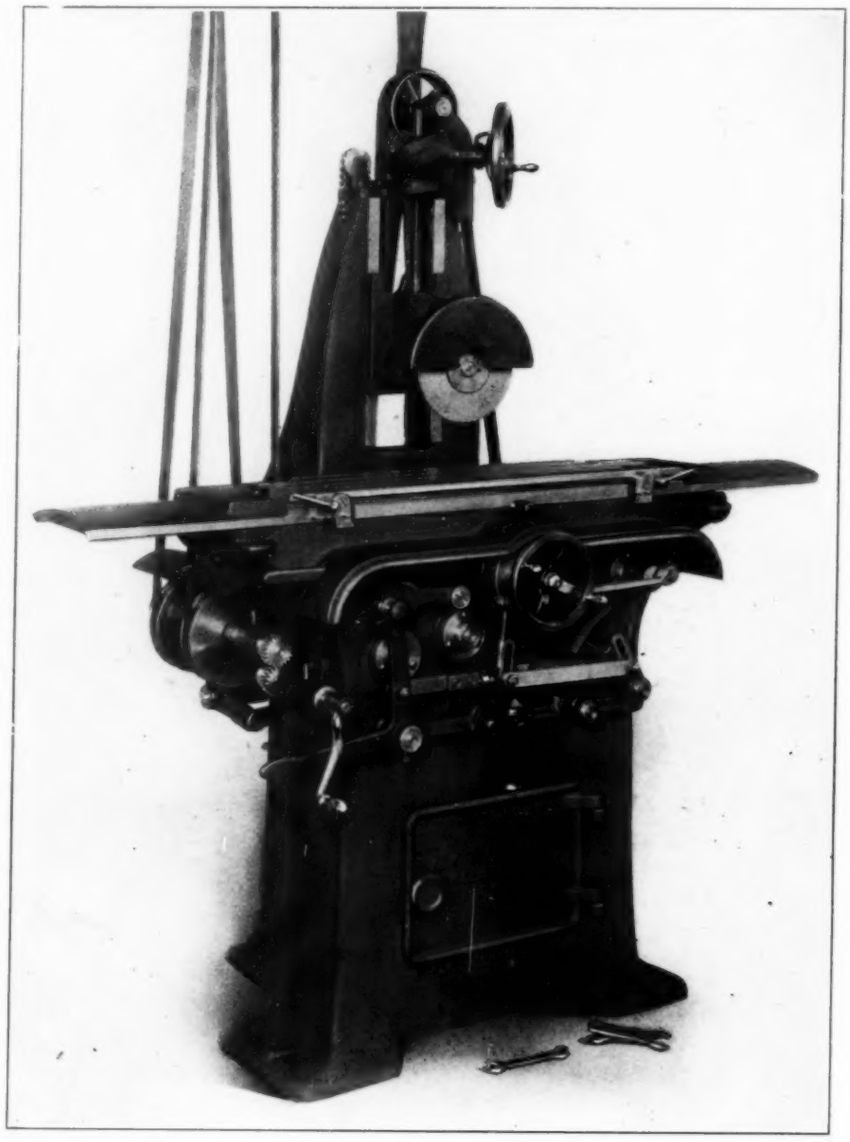


FIG. 1. WALKER GRINDER COMPANY NO. 3 SURFACE GRINDER

The automatic frictional reversing mechanism, as shown in detail in Fig. 3, is driven from the main countershaft by two belts, one open and one crossed, leading down to pulleys which operate the train of feed gears through the friction clutches. A clutch-shifting fork lever 80 stands in a

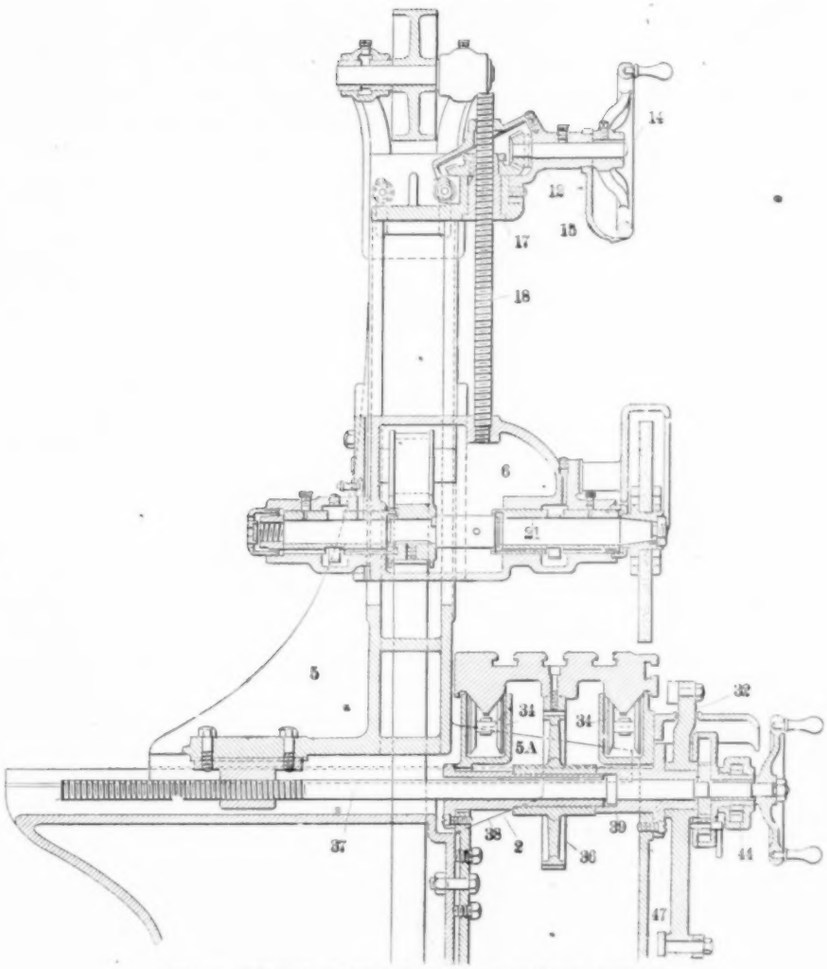


FIG. 2. DETAILS OF THE NEW NO. 3 WALKER GRINDER

vertical position underneath the clutch pinion shaft 77, and is hinged on a horizontal stud. At the bottom of the aforesaid fork lever is a horizontal projecting arm 80A, which connects with a second horizontal arm 91 attached to the clutch reversing shaft 87. Motion is transmitted between the levers 91 and 80A in vertical planes at right angles to each other, this being accomplished by a ball-and-socket joint. Each of the friction drive pulleys 70 and 71 are bored for the reception of split friction rings 73 which are carried on flange spiders 72 pinned to the clutch pinion shaft 77. These friction rings 73 are cut apart at diametrically opposite points, and the separated parts are held down to their seats by means of a coil spring.

In one of the openings between the ring segments is fitted the steel jaws, each of which has a pendent-projecting lever portion extending in a radial line toward the center of the clutch, and lying in close contact, except for a narrow opening between the ends of each for the insertion of operating wedges 74, there being one of these for each clutch and both being fast to the sliding sleeve 75, which is operated by the clutch fork 80. The steel jaws have circular seats in the clutch ring and roll together with a very short toggle-joint leverage so that a tremendous expanding power is obtained for the friction rings 73. On the opposite side from the expanding jaws of the friction-ring segments is formed a conical seat for the conical adjusting screw 78. This screw is tapped through the exterior flange of the clutch spider 72 and is held in place after adjusting by the check nut 79, easily accessible on the outside.

To adjust this clutch, it is only necessary to insert a screw driver through the hole 71A on the back side of either pulley, turning the clutch around until the screw 78 can be reached. Then, holding the same with the screw driver, the nut can be loosened and the adjustment made, afterward re-tightening the nut. It will be seen that there is but one adjustment of this clutch, and that it is very simple and positive. The advantage claimed for the friction clutch over the usual toothed clutch lies in the fact that it is practically noiseless, no matter at what speed it may be run. It is also very durable, as the wearing surfaces are large, and there is little or no slippage to create wear.

The pulleys 70 and 71, of course, turn in opposite directions by means of the belts before referred to, thus obtaining a reversing action of the clutches. Each pulley has an extended side bearing running in boxes 81, and each bearing is made hollow, forming bearings for the clutch pinion shaft 77, which is slow running and is oiled from the center as shown. Pinions 84 gear this shaft to the hand-crank shaft 85, which can be pushed in or out, and the pinions thrown in or out of mesh at pleasure.

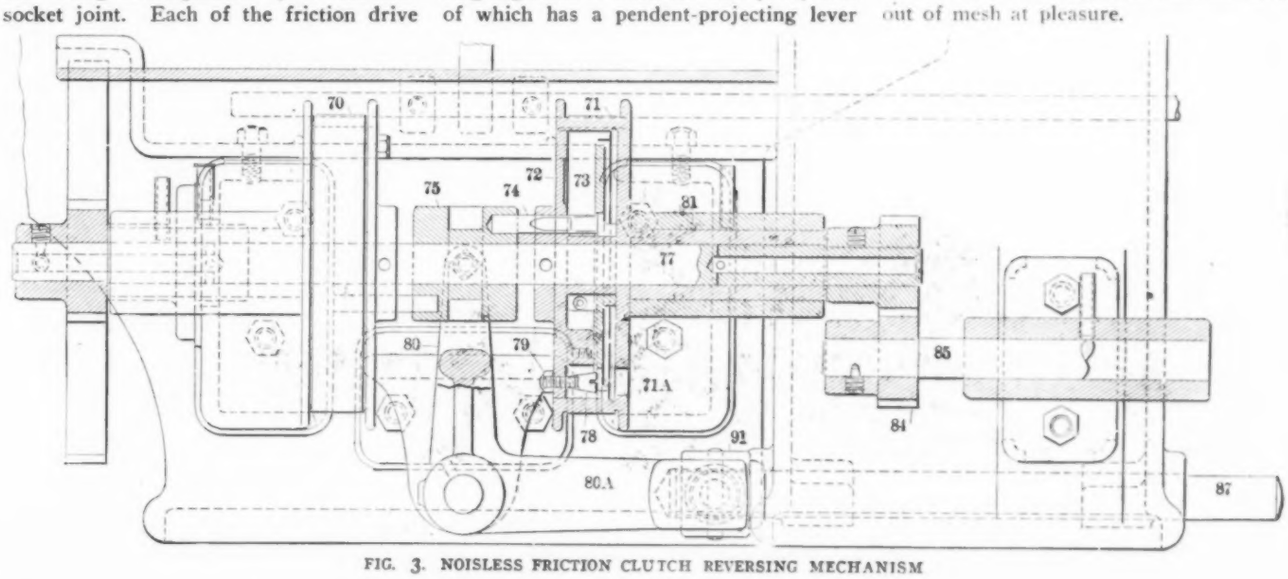


FIG. 3. NOISLESS FRICTION CLUTCH REVERSING MECHANISM

The machine carries grinding wheels 10x5⅝ inches. It will be furnished, when desired, with a magnetic chuck built integral with the platen, or a separate magnetic chuck 26½ inches long can be used on top of the platen.

The longitudinal movement of the platen is 30 inches, the cross-feed movement 8 inches, and by the use of an 8-inch wheel 10⅜ inches in hight can be ground.

The net weight of the grinder is about 1700 pounds, and is manufactured by the Walker Grinder Company, of Worcester, Mass.

Lathe for Turning Projectiles

The Bement works of the Niles-Bement-Pond Company, Philadelphia, Penn., have recently turned out a lathe for the Firth-Sterling Company, Washington, D. C., for turning projectiles.

The actual swing over the bed is 27⅞ inches and over the carriage 17¾ inches, while the longest work that will go between centers is 8 feet 4 inches. The face plate has four heavy independent chuck jaws for holding and driving the work, which is guided by the steady rest holding any projectile from 6 to 13 inches in diameter.

The lathe is driven by a direct-connected 12½ horse-power motor located on the base plate and has a speed range of 1 to 4, giving from 9½ to 38 revolutions per minute of the work. The starting lever in front of the headstock gives convenient control of the powerful friction clutch which transmits the driving power to the work and enables starting and stopping instantly.

Both screw and rack feeds are provided and there are nine changes of feed for each. The carriage slides are specially arranged so that in addition to the hand cross feed it is controlled by an arrangement of links which carries the tool so as to turn the radius or curved end on the point of the projectile.

Everything is made very heavy and rigid, as will be seen from the tailstock, which has a set-over and a pinion for moving along the bed.

The Landis Stay-bolt Cutter

A new stay-bolt cutting machine, illustrated by the accompanying half-tone Fig. 1, is a development of the Landis bolt cutting machine, uses the same kinds of dies and is built by the same firm, the Landis Machine Company, Waynesboro, Penn. A chaser is illustrated by the line engraving, Fig. 2. The machine shown is a double head, although they are made both single and double, in sizes up to and including 1½ inch. The machine needs but little detailed description. Both spindles are driven by gearing from a three-step cone. The carriages have adjustment both up, down and sidewise, so that the cutting strain can always be kept central. The racks for the carriages are provided with recesses between the teeth so that chips or dirt will fall through and not clog and interfere with the tooth action. There are ample provisions for lubrication, a large pan, tank and oil pump.

The feature of the machine is the Landis die containing the special chasers. These chasers are each four inches long with teeth milled on one flat side and running for the entire length, as shown by Fig. 2. In use these chasers are set tangent to the bar and at the correct

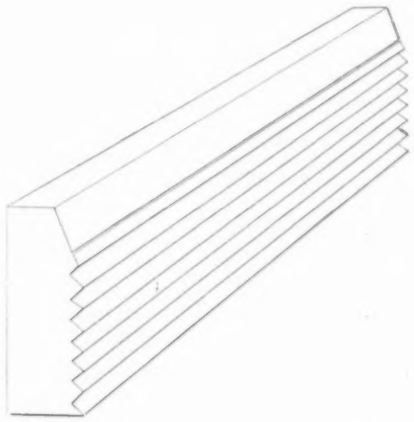


FIG. 2. CHASER FOR LANDIS STAY-BOLT CUTTER DIE

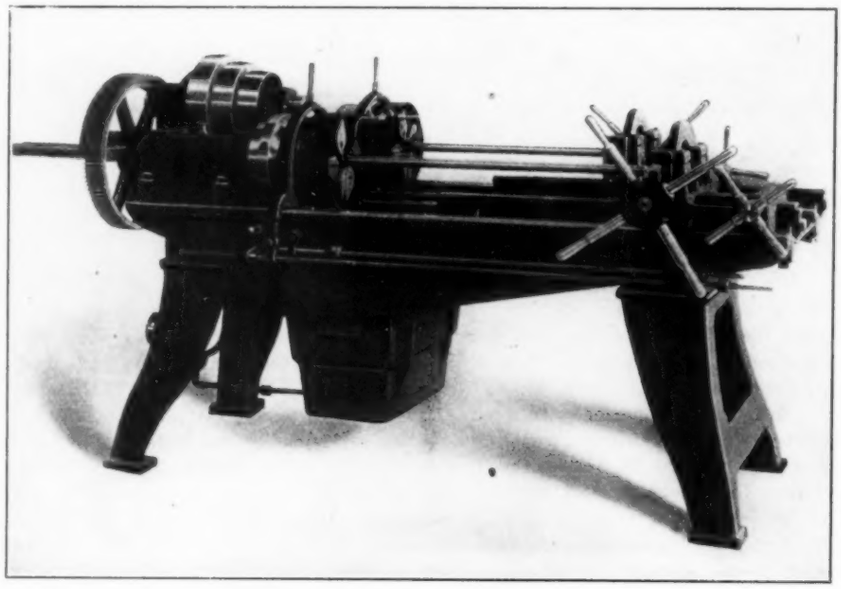
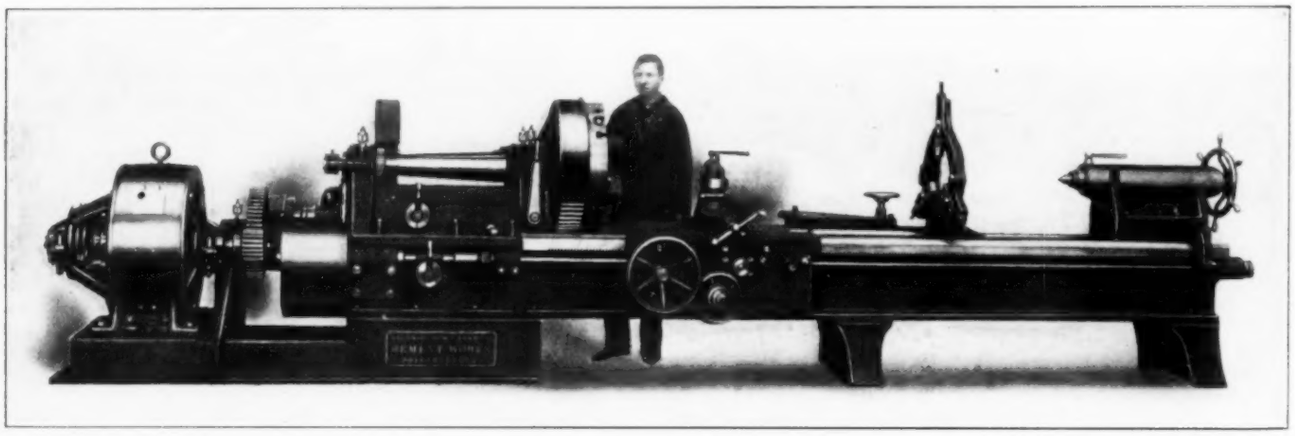


FIG. 1. LANDIS STAY-BOLT CUTTER



LATHE FOR TURNING PROJECTILES

angle. They can be ground to any rake desired in order to suit the kind of material to be cut. A rolling chip is produced very similar to the chip from an ordinary thread-cutting tool in the lathe.

All of the chasers are made interchangeable. No lead screw is used on the machine to govern the pitch of the thread being cut, as all of the cutting is done by the leading teeth of the die and the following teeth of the four chasers form a lead nut controlling the motion of the bar and making it conform in its motion to the pitch of the die. When the die is ground not only are the teeth used in cutting ground but also those which govern the pitch of the thread, thus its accuracy is at all times preserved.

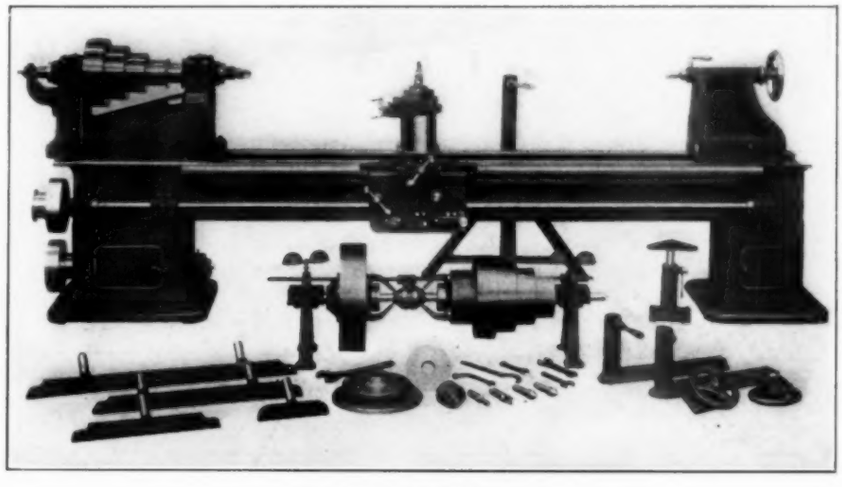
A Patternmakers' Lathe

The illustration shows a lathe built especially for the use of patternmakers. In this lathe the V's for the carriage are at the sides and below the top of the bed so that they are not liable to be injured by tools lying on the bed.

The head is provided with a double-ended spindle, having a 7/8-inch hole through it, which runs in self-oiling boxes. The head may be swivelled in either direction 5 degrees from the center line. The cone pulley is machined inside and out and the large end of it is closed to prevent dust and dirt collecting in it and destroying the balance. The spindle thrust is interchangeable and fits either end of the spindle.

The carriage can be fed by hand or power in either direction. There are two gradations of feeds, 1/16- and 1/8-inch per turn of the spindle. The compound rest is graduated so that it can be set to any desired angle.

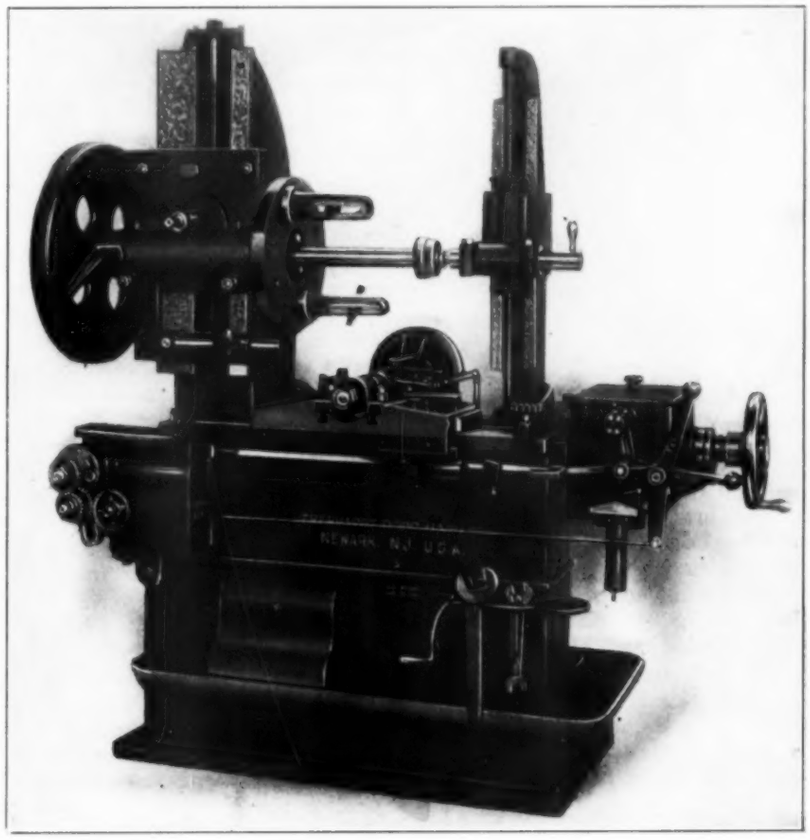
These lathes are built in three sizes, 20-, 26- and 32-inch swing, by the American Wood Working Machinery Commany, Rochester, N. Y.



A PATTERNMAKER'S LATHE

A No. 3 Automatic Gear Cutting Machine

The accompanying half-tone illustration shows a new size of automatic gear-cutting machine recently put on the market by the Eberhardt Bros. Machine Company, of Newark, N. J. It is designated as the No. 3 size and has a capacity up to gears 36 inches in diameter and 10 inches face. It will cut 4 diametral pitch teeth in cast iron and 5 diametral pitch teeth in steel at one cut, using a fast rate of feed. It is designed for the cutting of spur gears only within the range which we have mentioned. Its long capacity as regards the length of face, namely, 10 inches, is of considerable service where several gears can be placed on the arbor at once. This feature is made possible by the arrangement of the frame and cutter slides, in which the slide can travel past the column of the machine for a certain distance and thus bring the cutter spindle very close to the column itself. The general mechanism of the machine is similar to that of the other sizes produced by this firm, embodying the positive indexing mechanism, the spur-gear drive for the cutter spindle, the feed screw in tension, and the long cutter carriage with the spindle in the center of its length. A good feature of the design is the arrangement of the feed and the hand controlling handles. These are on the side of the machine and near the hand-wheel at the end, so that the operator in setting his work has control of all the machine movements without changing his position.



A NO. 3 AUTOMATIC GEAR CUTTING MACHINE

The Derrer Universal Shape Attachment for the Lathe

The illustrations show this attachment on the engine lathe and some of the work produced by it. It is fitted to or is preferably a part of the taper slide of the carriage of an ordinary lathe with taper

attachment. In the bearing at the rear of the slide, Fig. 1, is a sleeve carrying an eccentric connected to the cross slide of the lathe by means of the eccentric strap and rod, the cross-feed nut being disconnected to allow the cross slide to move freely upon the carriage.

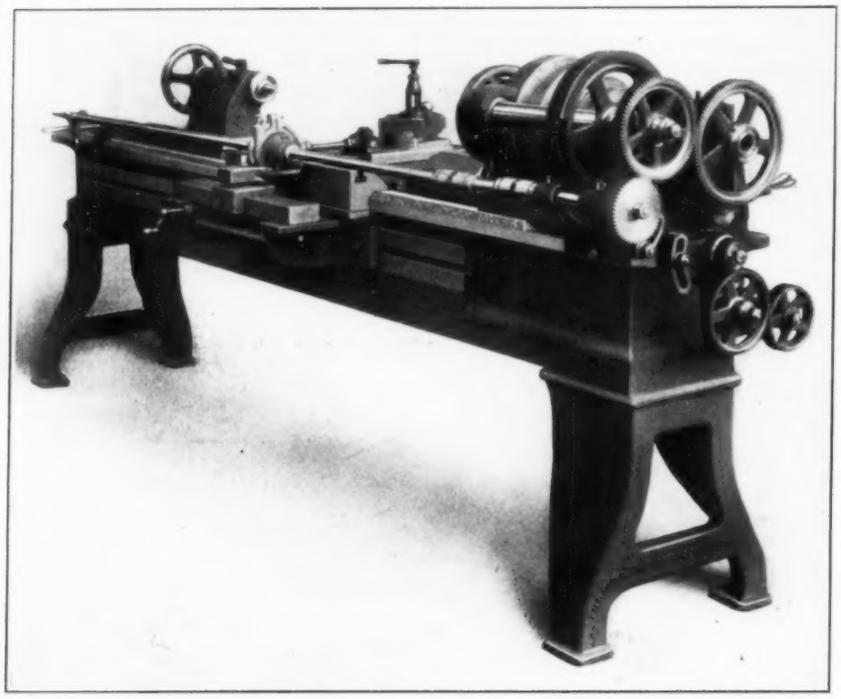


FIG. 1. UNIVERSAL SHAPE ATTACHMENT FOR THE LATHE

The splined shaft which passes through the sleeve connects by means of a pair of universal joints and set of gears, with the large driving gear on the end of the spindle. Suitable gears are furnished to give this shaft speeds in the ratios of 1 to 1, 2 to 1, 3 to 1 and 4 to 1 with the spindle. As the attachment interferes in no way with the regular taper attachment, tapered as well as straight, eccentric, oval, square, and multi-lobed work may be bored and turned.

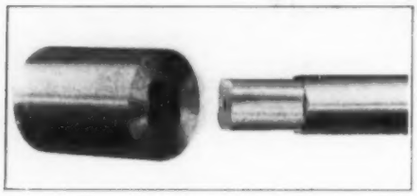


FIG. 2. SHAFT END AND COUPLING

An adjustable eccentric is furnished with the attachment, which is composed of two eccentrics, one within the other, the inner one having an oval tapered hole to fit upon a tapered oval seat on the sleeve; the outside of this eccentric is given a slight taper and the outer eccentric is bored to fit it. By turning them one upon the other it is possible to obtain any throw from 0 to the amount of the combined throw of the eccentrics. The face of the outer member is graduated to facilitate making the settings and when located at the required position to give the desired eccentricity the two are simply pressed together.

Some of the uses to which the attachment may be put are the relieving of taps and cutters, the turning of eccentric shafts for back gears, and punch presses, and oval boring and turning, etc., the last named being perhaps its most novel use. If it is desired to fix a piece upon a shaft it may be bored with an oval taper hole, the shaft turned with an oval tapered seat to fit it and the two parts pressed together, no keys or screws being required to prevent slipping or turning.

As the tool at all times is tangent to the cut in boring or turning (either straight or taper), two ends of a taper hole would form similar ellipses, having the two diameters of the ellipses a constant ratio to each other. It may be stated that the oval drive has been in practical use for the past two years throughout the plant of the Algonia Steel Company, Sault Ste. Marie, Ont.

Fig. 2 shows one form of shaft coupling with the end of the shaft made to fit it, as produced with this device. Couplings may also be made with the boss on one member machined oval to fit an oval seat in the other half. Fig. 3 shows the end of a shaft turned square with a gear bored to similar form to receive it, there being no chance for slip or twist to occur when the two parts are pressed together.

The principle of the oval taper is being applied by the manufacturer of the device

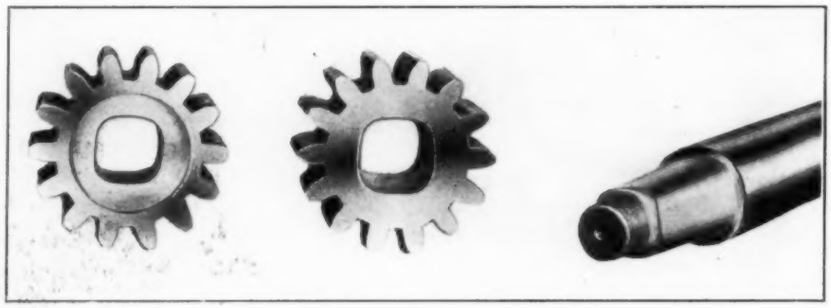


FIG. 3. METHOD OF FITTING SHAFT AND GEAR

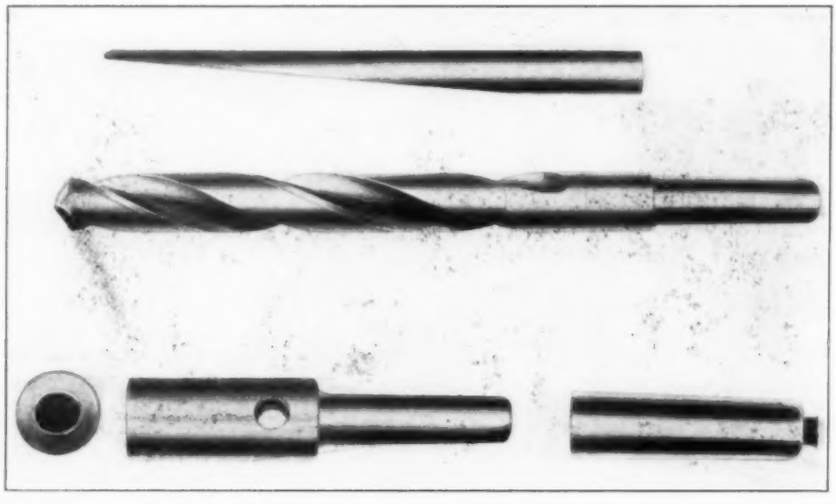


FIG. 4. TWIST DRILL WITH OVAL SHANK, OVAL SOCKET AND SLEEVE

—the Lancaster Machine and Knife Works, Lancaster, N. Y.—to the shanks of twist drills, in place of tangs. Fig. 4 illustrates a drill as made by the company with this form of shank and also shows the holding socket and sleeve and the drift for removing the drill. The scheme is practically self explanatory, especially as line drawings are presented in Fig. 5 showing in detail the socket and sleeve. It will be noticed that the drift is applied through a cross hole in the socket, while the sleeve carries a longitudinal pin which when struck acts as an ejector.

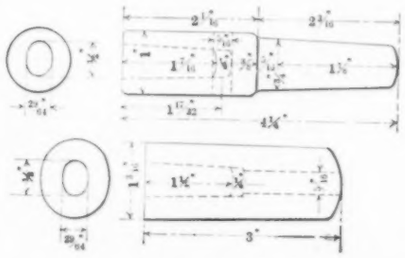
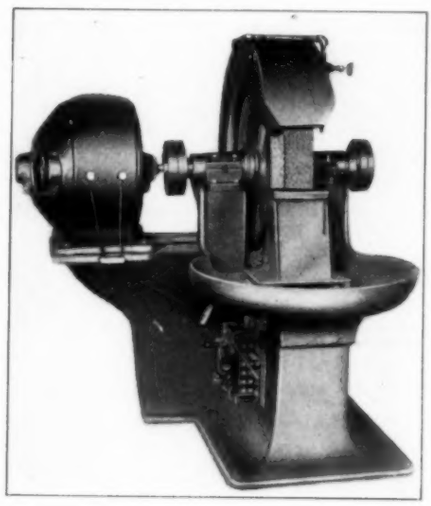


FIG. 5. DETAILS OF DRILL SOCKET AND SLEEVE

Grinder for Large Tools

Users of large lathe and planer tools have sometimes found it difficult to grind these properly on the face owing to the shank of the tool striking the edge of the apron. To avoid this difficulty the apron of this machine has been lowered as shown to allow any angle desired to be ground on the face of the tools.



GRINDER FOR LARGE TOOLS

The base of the tool forms a large water tank from which it is supplied to the wheel by a centrifugal pump. The grinder is made in two sizes, one for a 26x4-inch and the other for a 20x2½-inch wheel, and is made for either belt or motor driving.

The weight, with a motor, is 2600 pounds, the spindle is 3 inches in diameter with an 8-inch bearing and the proper speed is given as 425 to 450 revolutions per minute.

It is made by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn.

High Charges for Repair Parts

BY JOHN SMITH

An article in the AMERICAN MACHINIST, "High Charges for Repair Parts," has been called to my attention. It seems to me that the writer of this article was not giving the manufacturer a fair show, that an injustice has been done in writing an article of this kind and that more conservative articles ought to be written on this subject.

A manufacturer should be well paid for repairs—much more so than for staple articles or anything else that is manufactured in comparison. A repair is generally for a small item that is outside of the regular work. It requires attention of the very best of help to select this repair, see that it is properly shipped and will answer the purpose for which it is intended. Repairs are frequently kept for many years in order to supply this urgent demand. Frequently when about to change the design of an article that is being manufactured, care must be taken to provide for repairs for those articles that are out. An estimate should be made of about what repairs might be needed; space must be provided to store these repairs. In the meantime, certain portions of the repairs may be called for more rapidly than others. As you are not manufacturing the article, the patterns and jigs may be misplaced or gone; the workman skilled in making these is now not familiar with this piece of work. This single article may necessarily be made at a great disadvantage. If you should charge a man in the first case a low price for the repair, and in the second case should charge him the price that it cost to make the single article, you certainly would make him an enemy forever. Sometimes people are obliged to destroy patterns of obsolete machines in order to make room for other work.

Most people take it for granted that repairs are the fault of the manufacturer, not of the user, and, therefore, that the manufacturer should furnish the repair either free of charge or at a nominal price. I have driven along a road where I could hear a windmill squealing a half a mile off. All of us have seen men driving automobiles in a way that will soon make repairs necessary. In my own shop vises have been broken with a clean break 3 inches through.

One day a man brought a jaw of a high-priced vise to me to see if I could make him a new one. I asked him how he broke it, and he stated that he had tried to straighten a good-sized bar, cold. I told him that he had now better buy a new vise and learn a lesson, as there was no way that this jaw could be replaced, for the maker's name was not on the vise.

I have built automobiles; when I had a number of parts left over from an old model the question was, "Shall I work these up into new cars, or what shall I do with them?" I said to the superintendent that we most likely would need some of them. In such a case it is necessary to set the price of these repairs so that what is received from a few will more than pay for what should be received for the whole lot, for some of them will never be called for; but it is impossible to tell in advance. All people expect a repair to be furnished immediately on a telegram order, and are more pleased with the prompt shipment of a repair than they are for a high charge for it.

A few days ago I was getting out some screws for repairs. I had marked a price of 5 cents each for them. One of the employees called my attention to the fact that he thought this was rather a high price, for they did not cost over 1 cent each. This cost is what we would pay for several thousand at a screw factory. These screws must receive considerable handling, and in order to get out an order one of the best men in the shipping room must hunt around through the shop and get the exact screws wanted. Frequently they are sent out by mail, an order having first been made out. Someone must examine the order; another get a suitable box or envelop in which to place the screws, carefully wrapped; an invoice is made out, charged on the books and then a collection made. Possibly several letters must be written because the purchaser thinks he has been overcharged, for the party receiving the articles does not appreciate the time and care taken to fill the order.

It may be that breakages occur from fault of design; but designers are not all wise, nor can they foresee all conditions, and if the manufacturer wishes to live in business he must either add this to the first price of the machine, or, in a more just way, place the price on a repair, for some men will break it and others will not. The one that does not break his tool should not be called upon to pay for the carelessness of others.

When a list of repairs is made out, the sum of these repairs amounts to much more than the entire machine, and the small items are charged more in proportion than the large items. The charge does not apply wholly to the value of the repair, but is similar to the case of a lawyer or a surgeon. It is not the time he puts in just at that moment, but being prepared to perform the service at the time it is needed has a great deal to do with the charge.

[We believe everything should sell at a

fair price, and any expense attached to keeping old parts in stock naturally adds to the cost; but we still believe that it is more important in the long run to keep your customers running at a nominal cost for repairs than to have them feel that repairs are a constant expense. Some of the best known firms in machine lines work on this plan.—Ed.]

A Special Graduating Machine

By H. F. Noyes

This machine, shown in the accompanying illustrations, was designed for graduating the intermediate plate, as it is called, used on the Landis crank grinding machine. The plate, which is illustrated in Fig. 1, is a plain disk, having a hole *A* located at (in one size of machine) a radius of two inches from the center pivot *B*, and the pivot locates it on another or face plate, two inches from the center of that plate. By referring to the sketch, Fig. 2, it will be evident that, by turning the intermediate plate upon its pivot, the hole *A* describes a circle which cuts the center of the face plate and also a point located four inches from that center, and that, when a crank-shaft is clamped to the intermediate plate with its journals centered in a fixture which is centered in the hole *A*, the journals may be thrown out of center with the face plate any distance up to four inches.

The intermediate plate is graduated upon its periphery to indicate the amount of eccentricity of the crank, and the machine was designed for marking these

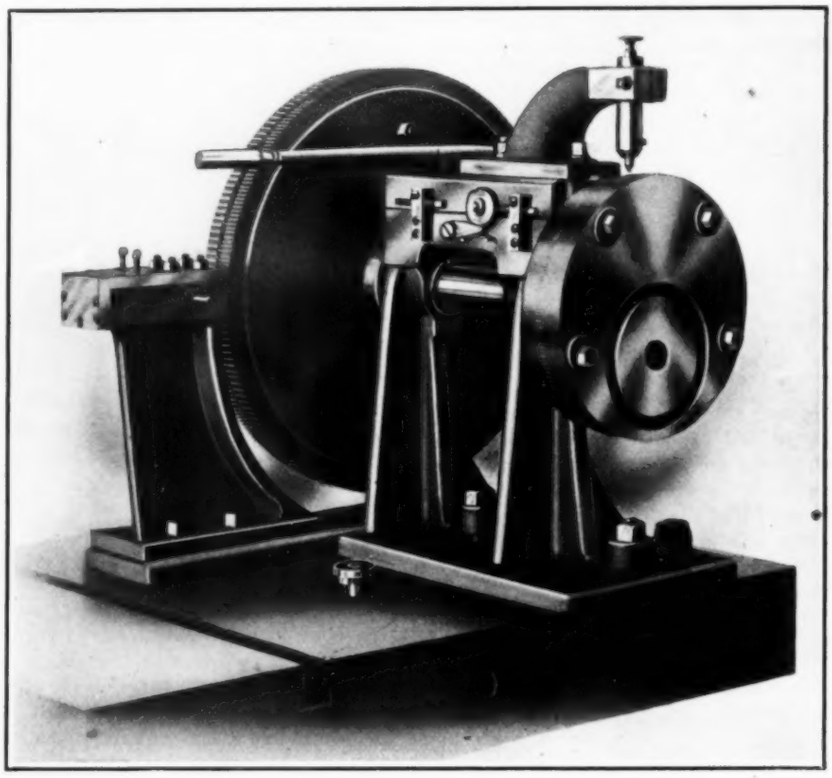


FIG. 3. THE GRADUATING MACHINE

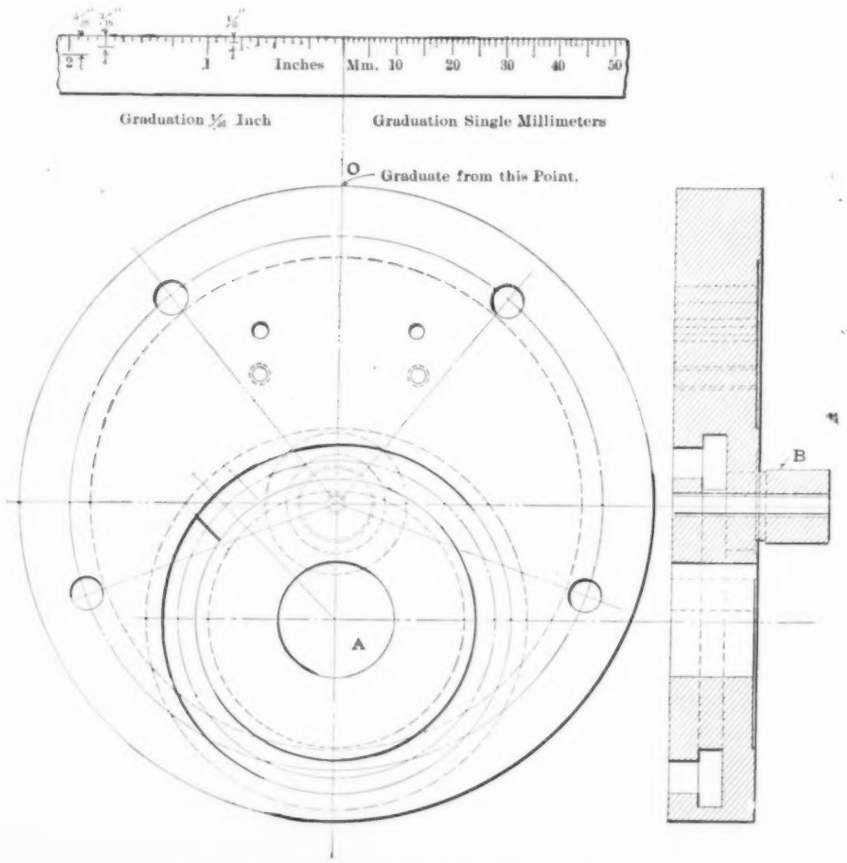


FIG. 1. THE INTERMEDIATE PLATE AND ITS GRADUATIONS

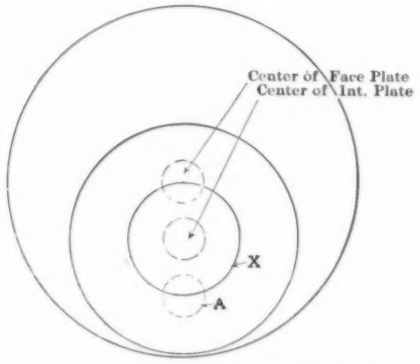


FIG. 2. ARRANGEMENT OF INTERMEDIATE AND FACE PLATES

graduations. It will be evident that, while the graduations are upon the periphery, they must indicate the distance in a straight line from the center of the face plate to the center of the journals, or in other words the throw of the crank, and, in order that the latter may be indicated in equal divisions, the distance apart of the divisions upon the periphery of the intermediate plate must vary.

On account of this fact the building of an automatic indexing machine would have been too expensive for the number of plates manufactured, and the machine was therefore designed to be indexed and operated by hand.

The machine, illustrated by Figs. 3 and 4, comprises a stiff base carrying a face

plate on one end of an arbor to hold the plate to be graduated. At the other end of the arbor are fastened two disks provided with notches, located a proper distance apart, to produce rightly spaced graduations. At the side of each disk are located two plungers, one adapted to engage the notches in each disk. Two disks are necessary because the plates are graduated in rights and lefts.

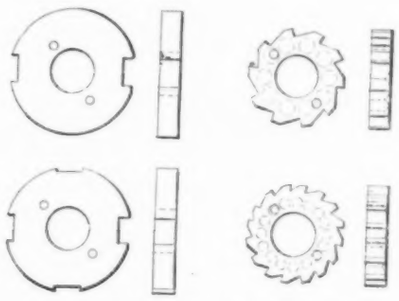


FIG. 5. DISKS AND RATCHETS OF THE GRADUATING MACHINE

The marking is effected by means of a slide, operated by hand, which carries in a small head a marking tool adapted to be readily raised or lowered.

Automatically indexing stops are provided to regulate the length of the stroke; both English and metric graduations are used, one-half the plate being marked with English and the other half with metric, and a complete set of stops is provided for each. The graduations for the English measurements represent varying throws by sixteenths up to four inches, and for metric by single millimeters up to 100.

For the English graduations, the stop comprises a 16-toothed ratchet combined with a four-notched disk fastened together upon a pin carried by the slide. An adjustable set-screw is arranged upon the base in line with the movement of the disk, and a pawl to engage the ratchet; so that upon the forward stroke the movement is limited by the disk impinging upon the set-screw; on the return stroke, which is limited by another stop, the pawl moves the ratchet around one tooth. Thus three strokes will impinge upon the outside of the disk, marking sixteenths; the fourth will bring one of the notches opposite the stop, making a slightly longer stroke for one-quarter inch mark; then three more sixteenths; then a slightly longer stroke for one-half inch as the next notch is reached, and so on. The depth of notches is arranged to suit the desired length of graduation for one-fourth, one-half, three-fourths and one inch respectively.

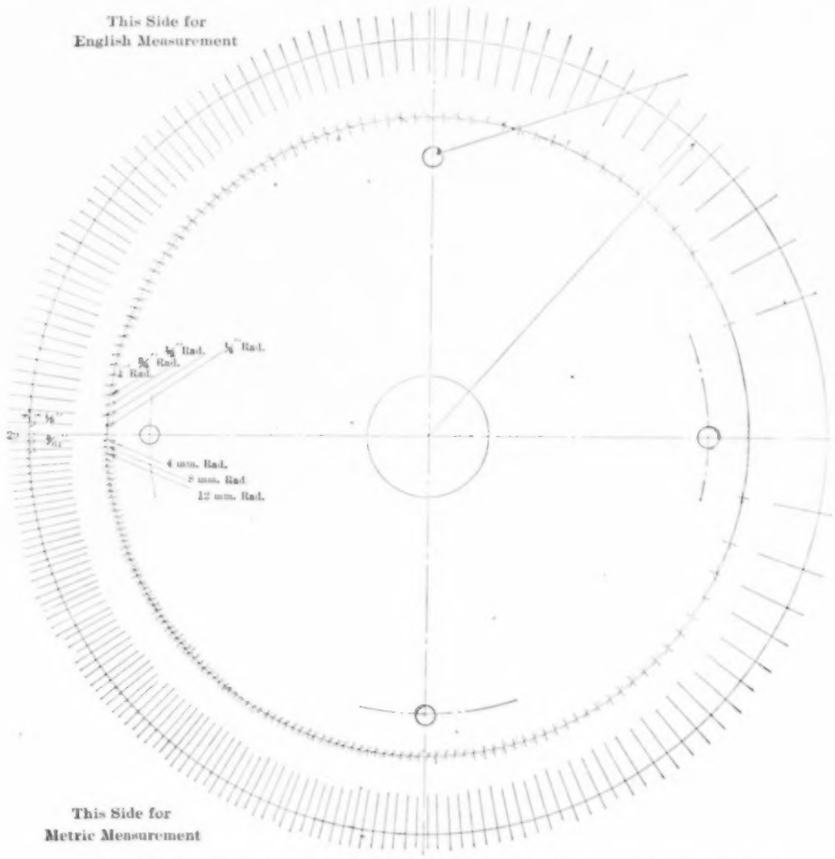


FIG. 6. DIAGRAM SHOWING METHOD OF LAYING OUT THE INDEX TABLES

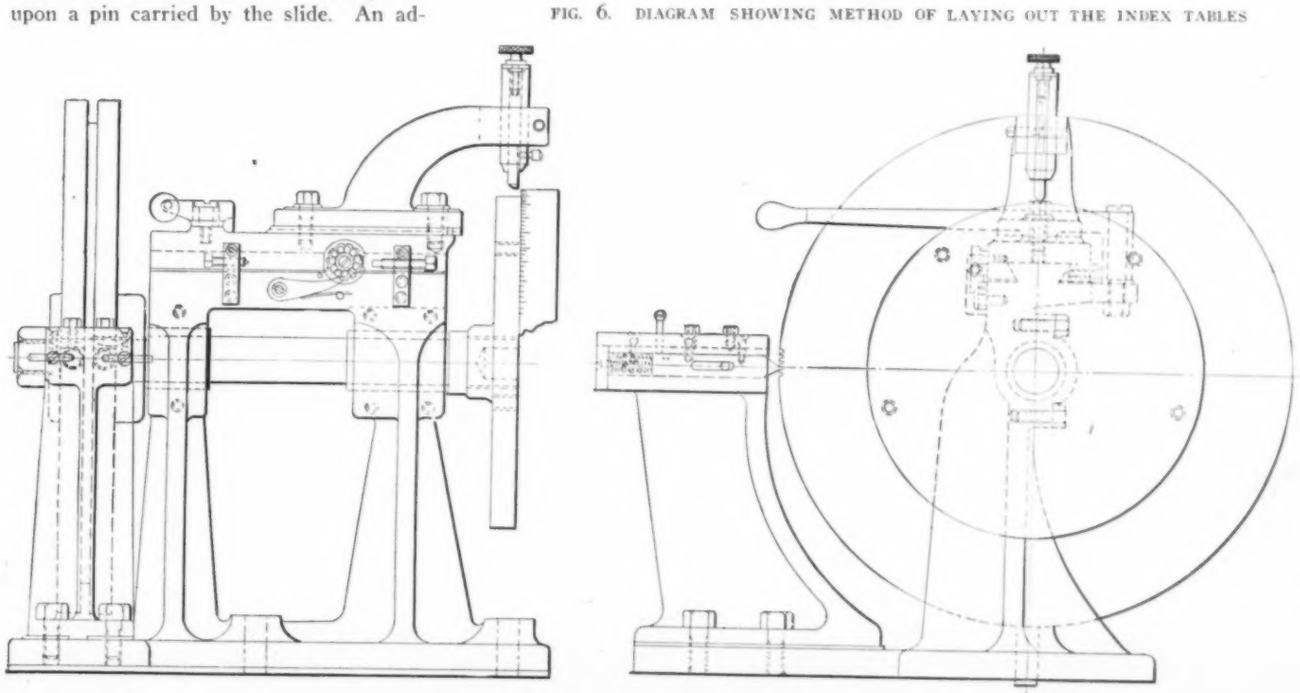


FIG. 4. DETAILS OF THE GRADUATING MACHINE

For millimeter graduations, a two-notched disk is combined with a 10-toothed ratchet and arranged in a similar manner. Details of these disks and ratchets are shown in Fig. 5.

The index plates on the back of the machine are made as large as possible, in order to reduce the probable error. The drawing, Fig. 6, shows the method of laying off these plates for milling. A 16-inch circle, four times the throw, is struck on the plate and with dividers set as closely as possible by a glass to the different divisions required. Radii are then struck, crossing the circle. Through the points of intersection radial lines are drawn to the edge of the plate. The plate is then set up in the milling machine and centered as carefully as possible to one of these lines. A pointer is clamped to the machine and centered by the glass to the same line. This notch is then milled and the next mark located by the pointer with a glass. In this way very good results were obtained, as the slight error found would be divided by four in the final indexing of the plate.

To make the plates rights and lefts two were clamped and milled together, and then one was reversed when placed on the graduating-machine arbor.

Inquiry for Machinery

(187) Wanted—A machine to put in place small rivets, ready for heading, taking them from a hopper automatically.

Business Items

Wilmarth & Morman Company, Grand Rapids, Mich., have received oders within the past few weeks from France, Norway, Sweden, Russia, Denmark, England, Germany, Holland, Australia, Brazil and Cuba.

Robert W. Hunt & Co., inspecting and consulting engineers, Chicago, has opened a branch office and chemical laboratory in St. Louis. This will be under the charge of Chas. W. G. Bennett, Jr., formerly western sales agent of the Atha Steel Casting Company.

The Republic Belting and Supply Company, Cleveland, Ohio, has been appointed exclusive agent for Becker-Brainard Milling Machine Company, Hyde Park, Mass., for the Ohio territory. The machinery department has been put in charge of S. C. Cutler, who will be assisted by Wm. H. Mortimer.

Trade Catalogs

Wagner Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 78, illustrating and describing transformers.

B. P. Fortin Tool Company, Woonsocket, R. I. Catalog of universal jigs. Illustrated, 14 pages, 3½x6 inches, paper.

Scully Steel and Iron Company, Chicago, Ill. January and February stock list. Illustrated, 144 pages, 4½x7 inches.

Mires Fuel Oil Equipment Company, Norfolk, Va. Catalog describing oil forges, burners and furnaces. Illustrated, 14 pages, 9x11 inches, paper.

Builders Iron Foundry, Providence, R. I. Catalog of grinding and polishing machinery, countershafts, etc. Illustrated, 116 pages, 3½x6 inches, paper.

The Whitney Manufacturing Company, Hartford, Conn. Abbreviated catalog of chains, machine keys, chucks, etc. Illustrated, 12 pages, 6x9 inches, paper.

Reinforced Brazing and Machine Company, 2525 Liberty avenue, Pittsburg, Penn. Catalog describing method of brazing. Illustrated, 18 pages, 9x12 inches, paper.

Manufacturers

The New York Central Railroad will erect a $20,000 machine shop at Buffalo, N. Y.

The planing mill of M. A. Kreig & Company at Nelsonville, Ohio, was destroyed by fire.

The Northern Pacific Railroad will soon start work on the erection of car shops at Superior, Wis.

The Grand Trunk Railroad will build three additional shops at the locomotive works in Battle Creek, Mich.

The Ice Utilities Manufacturing Company, Carbon Hill, Ala., will install machinery for general woodworking.

The Kalamazoo (Mich.) Stove Company is said to be contemplating the erection of an addition to its plant.

The Otis-Fensome Elevator Company, of Toronto, will erect a factory in Vancouver, B. C., to cost $30,000.

The plant of the Carbolite Gas Company at White Pigeon, Mich., recently destroyed by an explosion, will be rebuilt.

The Chicago, Milwaukee & St. Paul Railway Company will build a $50,000 addition to the roundhouse at Minneapolis.

Plans have been completed for a chain of repair shops for the Boston & Maine Railroad at East Somerville to cost $2,000,000.

The Oil Well Supply Company, of Pittsburg, Penn., will erect a plant at Los Angeles, Cal., for the manufacture of well tools.

The Evan Reed Manufacturing Company, Sterling, Ill., will erect a new plant in the spring for the manufacture of boxes.

The Hancock-Holmes Foundry Company has been incorporated at Atlanta, Ga., by A. Holmes and others. Capital $25,000.

The Georgia, Florida & Alabama Railway will erect roundhouse, machine shop, blacksmith shop and power-house at Bainbridge, Ga.

The Tampa Northern Railroad Company, will build shops at Palmetto Beach, Fla., it is reported. John Pasco, Tampa, chief engineer.

The Morgan Company, Oshkosh, Wis., manufacturing sash and doors, will make improvements to its plant at a cost of $10,000.

It is reported that the Musgrave Company, of Des Moines, Iowa, may build a plant in northeast De Moines for the manufacture of wire fence.

It is reported that the J. T. Towsley Manufacturing Compay, of Cincinnati, builders of woodworking machinery, will erect a plant in Vincennes, Ind.

Richard H. Long, of Framingham, Mass., is incorporating a company for the purpose of manufacturing shoe machinery. The capital stock is $200,000.

The Dudley Adding and Billing Machine Company is reported as contemplating increasing the plant at Staunton, Va. G. W. Dudley is general manager.

The Carolina Motor Company, Greensboro, N. C., has been organized with $10,000 capital to manufacture motor cars. L. A. Fogler, G. W. Painter, and others, incorporators.

The plant of the Parkersburg (Ohio) Mill Company was almost completely destroyed by fire, causing a loss of about $100,000. The company manufactured crates, baskets, boxes, etc.

The Cedars Manufacturing Company, Vicksburg, Miss., has been chartered with a capital of $100,000 and will erect a plant in South Vicksburg for the manufacture of fancy woodenware.

The Safety Car Coupler Company, Chattanooga, Tenn., has been incorporated with $100,000 capital to manufacture a safety car couper. Incorporators, A. W. Boyd, M. A. Brown and others.

A machine shop ad foundry to be erected in Meridian, Miss., at a cost of $75,000 is being promoted by Frank Marty, Sr., at present patternmaker at the New Orleans & Northeastern shops.

The Lancaster Automatic Railway Crossing Company has been organized by A. J. Montague, Richmond, Va., and others. Foundry and machine shops will be established at Manchester, Va.

The Manufacturers' Supplies Company, St. Louis, Mo., has been incorporated to manufacture and deal in shoe machinery. Capital, $15,000. Incorporators, Frank M. Starboard, E. F. Spalsbury and others.

The Universal Auto Spring Company, St. Louis, Mo., has been incorporated to manufacture and deal in auto springs and supplies. Capital, $110,000. Incorporators, Frank G. Koehler, William Klasing and others.

The Milwaukee (Wis.) Car Manufacturing Company, incorporated with $50,000, is erecting a plant in which freight cars will be manufactured. Fred Pabst, Jr., Robert Nunnenmacher and T. F. Howe, incorporators.

The Woodley Manufacturing Company, of Norwalk, Conn., has been incorporated to engage in the manufacture of machinery and machine parts. Capital, $50,000. Incorporators, Elbert N. Sipperly, William T. Wood, etc.

The New England Metal Culvert Company is being incorporated at Palmer, Mass. The company owns the New England rights to manufacture a patented steel culvert and site for a plant has been purchased at Tennyville.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free.E.G.Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry and Parker, Erie, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machiney designed and built; duplicate parts, tools, jigs and dies. The Wade Machinery Co., 133 Oliver St., Boston.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Mechanics write for our special offer of how to get a set of wrenches free. Bullard Automatic Wrench Co., Providence, R. I.

Wanted—Exclusive agency for first class tool, machine or appliance for district having Baltimore as base. Box 788, AMER. MACH.

Special machinery designed and built; inventions, novelties, ideas, etc. developed. Albert Pott, M. E., 63 Bank St., Waterbury, Ct.

Special machines designed and built; duplicate parts, model or experimental work. Mantle, Park ave. and 129th St., New York.

Automatic machinery designed, ideas developed, work done by the hour at your place or mine. "G. C .H.," Box 751, AMER. MACH.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Designer of automatic and special machinery; mechanical drawings of any kind made. John G. Wittum, M. E., 93 Sherman Ave., Newark, N. J.

Wanted—To correspond with individual or firm with a view to establishing agency for Electric Cranes in New York and Philadelphia territory. Box 730, AMER. MACHINIST.

Have you any copies of December 12 and 19 issues of the AMERICAN MACHINIST? We will give fifteen cents for every copy that we can get. AMERICAN MACHINIST, 505 Pearl St., New York.

A mechanical engineer wishes to put some money in and assist in the management of the factory and sales of a small manufacturing business located in or near Philadelphia. Box 767, AMERICAN MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted — Machinists, toolmakers and draftsmen to join me in promoting a company; I have a good gas engine and need workmen as well as officers for the company with from $500 to $2000 each; such an opportunity is seldom offered. Box 786, AM. M.

Factory agents wanted to sell the B. and T. up-to-date toolmaker's aprons, in hickory and white drill, 50 inches long, tape attached to and drawn through brass eyelets, swinging micrometers, scale and waste pockets; 35 cents each; 20 per cent. commission; sample free. F. A. Thrall Mfgr., 230 6th Ave., Newark, N. J.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Tuesday, January 28, 1908, at 12 o'clock noon.
Dated New York City, December 17th, 1907. Robert McKean, Secretary.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Position wanted by a jobbing brass molder willing to go to any part of the United States; can handle any kind of metal, heavy or light castings; am a strictly sober and steady worker. Address "W," AMER. MACH.

CONNECTICUT

Foreman machinist wants position; experienced on engines and all kinds of machinery; extensive experience in handling help; excellent references. "S. S.," Box 787, AM. M.

ILLINOIS

Assistant superintendent manufacturing plant 3 years; 5 years' previous experience in machine shop and drafting room; 32 years old; Yale graduate; member of A. S. M. E.; location, in or near Chicago. Box 732, AMERICAN MACHINIST.

Superintendent of high character and executive ability, who is familiar with all details of manufacture in machine shop, blacksmith shop, pattern shop and foundry, on both light and medium heavy work of high grade, desires a position with a good reliable company; I know how to get results; best references furnished. Box 792, AM. M.

MASSACHUSETTS

By a designing draftsman, several years' experience in automatic machinery, jigs, fixtures and tools; A-1 references. Box 795, AMERICAN MACHINIST.

Is your production slow and costly? Try another superintendent more up to date, expert mechanic, executive, good organizer and systematizer; wide awake with long and varied experience as superintendent; light or medium manufacturing preferred. Address "Expert," AMERICAN MACHINIST.

Wanted—Position by first-class mechanical man, who is a mechanical engineer, expert designer of jigs and tools, A-1 draftsman, familiar with office work and accounts; as assistant manager, superintendent or purchasing agent; at present employed, but wish to make change; first-class references as to character and ability. Box 802, AMER. MACH.

MINNESOTA

Wanted—Position by experienced instructor in forge work position as instructor; good reference. Box 785, AMERICAN MACHINIST.

NEW JERSEY

An experienced designer of automatic machinery, inventive, practical, with a good record. Box 800, AMERICAN MACHINIST.

Draftsman wishes change; technical graduate, three years in machine shop, total engineering experience, eight years; moderate salary. Box 801, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 804, AMERICAN MACHINIST.

Experienced mechanical draftsman desires position. Box 791, AMERICAN MACHINIST.

Mechanical draftsman; artistic catalog illustrator, patent work; graduated; 6 years' experience; desires position. "Eureca," A. M.

Position by expert operator on semi-auto. turret lathe; will take charge or demonstrate; can devise tool equipment. Box 764, AM. M.

Foreman modern machine shop methods, successful in handling skilled and unskilled help, and reducing cost; A-1 references. Box 799, AMERICAN MACHINIST.

Mechanical draftsman; 24; wishes position; 5 years' broad experience at automatic and general machine line. Box 794, AM. M.

Tool room foreman; expert in all classes of accurate toolmaking; designer of the most modern sub-press dies, etc.; excellent organizer and cost reducer. "H.," AMER. MACH.

Wanted—Position by foundry foreman; young, strictly temperate in habits, well up in cupola practice and mixing iron and brass; thoroughly understands equipping and organizing new foundries; can furnish best of references; willing to go anywhere. Box 774, AMERICAN MACHINIST.

PENNSYLVANIA

Superintendent or assistant; a producer, familiar with modern shop systems, organization, tools and design, desires position. Box 793, AMERICAN MACHINIST.

Young man; technical graduate, with six years' shop and drafting room experience, wishes position with manufacturing firm to learn salesmanship. Box 766, AMER. MACH.

Foreman—Have been successful handling men and boys, drilling, milling, and assembling, typewriters; am toolmaker with all-around experience on jigs, die-making, and labor saving devices; present employers as reference; 27. Box 798, AMER. MACHINIST.

FOREIGN

Russia—Russian mechanical engineer upon for position in Russia; machinery designing and shop work experience; two years' practice with American machine concerns; prefer a large concern with modern methods; 35 years old. S. S. Gulanitzky, Kieff, Tarasovskaja, 29.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—A general foreman for works manufacturing switches for steam and electric railroads. Box 797, AMER. MACHINIST.

CONNECTICUT

Wanted—First-class man for superintendent of factory making complicated machines having close adjustments and large number of interchangeable parts; must be thoroughly up in modern methods; competent young man preferred. "Engineer," AMER. MACH.

ILLINOIS

Wanted—Foreman of shop to manufacture pulleys, hangers, couplings, etc.; must be thoroughly familiar with all details of work; state experience and salary wanted. Address "Transmission," AMERICAN MACHINIST.

LOUISIANA

Wanted—By a southern jobbing machinery house, controlling first-class agencies; a first class machine tool salesman. Box 775, AMERICAN MACHINIST.

MASSACHUSETTS

Mechanical designer; a first-class mechanical designer with large experience in designing high-speed steam engines wanted for permanent position in New England States; state age, education, experience in detail and salary expected; only detailed applications will be considered. Box 749, AMER. MACH.

Wanted—A superintendent to take charge of a long established manufacturing plant, employing about 250 hands turning out medium and light mechanical apparatus; must be thoroughly up to date, good mechanic, organizer, executive, aggressive and all other qualifications to produce the best possible results; good, permanent position for the right man. Box 796, AMERICAN MACHINIST.

MICHIGAN

Wanted—Experienced general foreman for machine department of large gas engine works. Box 456, Lansing, Mich.

NEW YORK

Wanted—A man between 30 and 40 years of age with at least ten years' experience in high grade machine work to teach classes in technical school, New York City; technical school graduate or man with teaching experience preferred. "R. L. S.," AMER. MACH.

Wanted— mechanical draftsman familiar with mixing and kneading machinery for bread doughs, chemicals, paint, etc.; to a man thoroughly conversant with this line of machinery, we can offer a good position; state age, experience, if married or single, and salary expected. Address "Mixers," AM. MACH.

Superintendent with experience and good executive ability, capable of taking full charge of the manufacturing end of a modern plant employing 250 men in the manufacture of a line of A-1 machine tools; location a pleasant town of 10,000 inhabitants, moderate rents, etc.; this is a good opportunity for the right man; state age, experience and salary expected, with references. Address "Manufacturer," AMERICAN MACHINIST.

OHIO

Top notch foundry superintendent wanted at once for new machine-molding gray iron foundry; the various buildings and equipment just being completed; strictly up-to-date including continuous pouring; applicant must be temperate in habits, of good character aggressive, and above all, a good executive; full knowledge of molding machines and best application of patterns thereto absolutely necessary; give full particulars, references, where employed at present, and state salary required; all communications treated confidentially; no cheap man need apply. Address The Cincinnati Milling Machine Co., Cincinnati, Ohio.

PENNSYLVANIA

Wanted—First-class tool and die maker who thoroughly understands sub-press dies, etc., to take charge of tool and die department in adding machine and typewriter manufactory. Box 803, AMERICAN MACHINIST.

WISCONSIN

Assistant superintendent with experience in manufacturing the highest grade of machine tools (preferably milling machines); a man with a thorough knowledge of accuracy requirements and understanding how to attain it at least cost; must be capable of handling details and have executive ability; state age, experience and salary expected. Kearney & Trecker Co., Milwaukee, Wis.

Draftsman with experience in designing machine tools for the market and the neces-

sary jigs and fixtures to manufacture them accurately and economically; a man capable of doing original work—no copier wanted; must understand modern drawing room practice and filing systems; state age, experience and salary expected. Kearney & Trecker Co., manufacturers of milling machines, Milwaukee, Wis.

For Sale

For Sale—Foundry, wood and iron machine shop; all equipped. Box 74, Albion, N. Y.

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Clark Cast Steel Cement Co., Shelton, Conn.

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Coils
Standard Welding Co., Cleveland, Ohio.

Collets and Attachments, Spring
Adjustable Collet Co., Cleveland, Ohio.

Compound, Core
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg.. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Blaisdell Machinery Co., Bradford, Pa.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Machine Co., Taunton, Mass.
Ingle Machine Co., Rochester, N. Y.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Link-Belt Co., Philadelphia, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum
See Grinding Wheels.

Cotters
Adjustable Collet Co., Cleveland, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Manning, Maxwell & Moore, Inc., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Cranes
Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.

Cranes—*Continued.*
General Pneumatic Tool Co., Montour Falls, N. Y.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Manning, Maxwell & Moore, Inc., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.

Machine Department

Chain Department

Miscellaneous Department

We are now well settled in our New Factory and

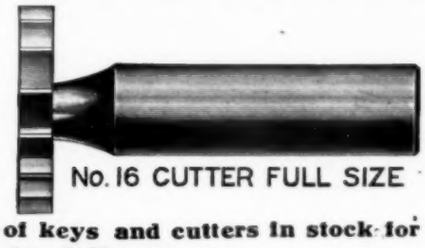
Ready to Show Results

Prompt Delivery and Constant Improvement in Quality

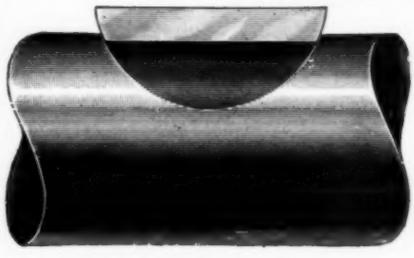
In our effort to possess the Finest Chain Plant in existence and to maintain the highest degree of Accuracy, Efficiency and Finish we are going to the very limit.

We will now make all sizes of Roller and Bushing Chains for which there is a reasonable demand.

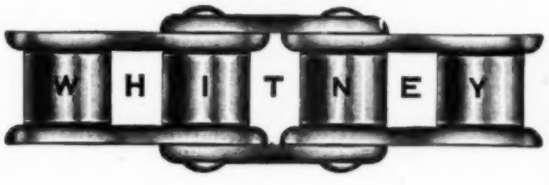
"WHITNEY" MACHINE KEYS and KEY-SEAT CUTTERS
(For the Woodruff Patent System of Keying)



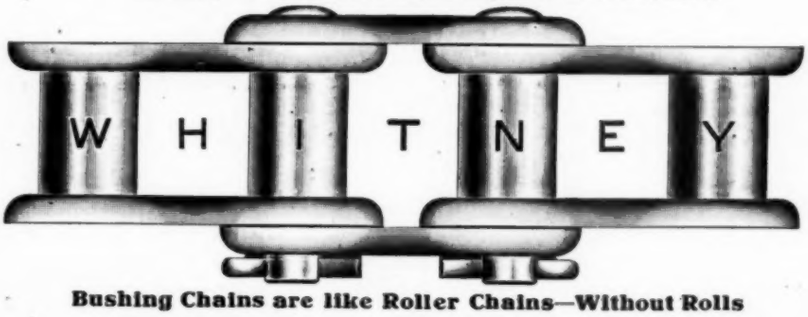
We carry 95 regular Sizes of keys and cutters in stock for immediate delivery.



Roller Chain



"Whitney" Detachable Bushing Chain—Patented



Bushing Chains are like Roller Chains—Without Rolls

The Whitney Mfg. Co.

Hartford, Conn.

Cutting-off Tools—*Continued.*

Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.

Dies, Sub-Press

Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Artisans Guild, Benton Harbor, Mich.
Kolesch & Co., New York.
Mittineague Paper Co., Mittineague, Mass.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Ct.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co. Cincinnati, O.

Drilling Machines, Upright—*Continued.*

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.

Drills, Rail

Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Manning, Maxwell & Moore, Inc., New York.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co. Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Manning, Maxwell & Moore, Inc., New York.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.